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GERMANY'S FOOD
CAN IT LAST?

THE GERMAN CASE
AS PRESENTED BY
GERMAN EXPERTS

ed. Paul Eltzbacher

ENGLISH VERSION EDITED BY
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WITH A CRITICAL INTRODUCTION BY
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London: University of London Press
AT ST. PAUL'S HOUSE, WARWICK SQUARE, E.C.
1915

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The Case as presented by the German Experts
and a Criticism

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GERMANY'S FOOD
CAN IT LAST?

GERMANY'S FOOD AND ENGLAND'S PLAN TO STARVE HER OUT

A STUDY BY GERMAN EXPERTS
EDITED BY
PROF. PAUL ELTZBACHER, OF BERLIN

ENGLISH VERSION EDITED BY
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London: University of London Press
PUBLISHED FOR THE UNIVERSITY OF LONDON PRESS, LTD.,
BY HODDER & STOUGHTON, WARWICK SQUARE, LONDON, E.C.
1915

PRINTED IN GREAT BRITAIN BY
RICHARD CLAY AND SONS, LIMITED
BRUNSWICK ST., STAMFORD ST., S.E., AND
BUNGAY, SUFFOLK.

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APPROXIMATE ENGLISH EQUIVALENTS OF THE WEIGHTS AND MEASURES, &c., USED IN THIS BOOK

1 Milliard = a thousand million = 1,000,000,000.

1 Billion = a million million = 1,000,000,000,000.

1 Mark = 1 shilling.

1 Calorie is the amount of heat required to raise one kilogram of water from 0° to 1° Centigrade.

Measures of Length:—

1 Centimetre = $\frac{2}{5}$ inch.
1 Metre = 100 centimetres = 39$\frac{2}{5}$ inches.
1 Kilometre = 1,000 metres = $\frac{3}{5}$ mile.

Measures of Area:—

1 Are = 100 square metres = 119$\frac{3}{5}$ square yards.
1 Hectare = 100 ares = 2$\frac{1}{2}$ acres.

Measures of Capacity:—

1 Litre = 1$\frac{3}{4}$ pints.
1 Hectolitre = 100 litres = 21$\frac{7}{8}$ gallons.

Weights:—

1 Gram = 15$\frac{1}{2}$ grains.
1 Kilogram = 1,000 grams = 2$\frac{1}{5}$ lbs.
1 Double zentner = 100 kilograms = 2 hundredweights (nearly).
1 Metric ton = 10 double zentners = 1 English ton (nearly).

PREFACE

EVER since the present great European war commenced the German food supply has been extensively discussed; at one time popular opinion, as judged from the newspapers, inclined to the view that Germany was on the verge of starvation; now there seems to be a tendency, in some quarters, to regard all reports of shortage of food as untrue. The translation and publication in English of *Die deutsche Volksernährung und der englische Aushungerungsplan,* by Professor Paul Eltzbacher and his committee of Berlin professors and experts has been undertaken because it was thought that there was no better way of bringing before the English public the facts of the case, as seen through German eyes.

The German experts state that England is endeavouring to starve Germany into submission; after carefully reviewing the home production and actual requirements of the German people, they arrive at the conclusion that, provided that the various measures they recommend are adopted, the nation, even if isolated, cannot be starved.

It is true that rigid economy will have to be practised, that irksome restrictions will have to be submitted to, and that a complete readjustment of production and standard of living must take place, and it is also true that the margin is a narrow one, but, with proper foresight and wise regulations, the home production of Germany is, they contend, sufficient to feed her large population.

It will be seen that this German treatise completely disposes of the cry raised by certain German politicians that English naval action will result in millions of German women and children dying of starvation.

Their own experts argue that if not a particle of food reaches them from abroad not a single man, woman, or child need die of hunger; so there is no real basis in fact for all the talk about the brutality and inhumanity of the "English starvation plan" as conceived by the German mind.

Professor Waller, in the introduction he has written for this book, brings into prominence the narrowness of the margin on which the possibility of the Germans feeding themselves from their own resources rests; this is of cardinal importance. If, as claimed in this memoir by her own leading experts, Germany can produce within her own borders just sufficient food for her entire population, it obviously rests with the German Government itself whether in the repartition of that sufficiency the ration of the soldier shall be increased at the expense of the ration of the non-combatant. The first person to benefit by any increase in food would be the soldier, hence the importance of the British Orders in Council of March 11th, 1915. No German woman or child can be starved unless by the direct action of the German Government.

The book being written with typically German minuteness and detail possesses in places a somewhat weighty character, but after careful consideration I have thought it essential to adhere as closely to the original as the different spirit of the two languages would allow, rather than give an abridged and more popular version.

It is interesting to note how many of the measures advocated in this book have been adopted in Germany, such as prohibiting the export of sugar, the use of potatoes and wholemeal in making bread, the slaughter of pigs, the employment of prisoners of war to reclaim moorlands and assist in the cultivation of the fields, and the active endeavours being made to persuade the German people to boil potatoes in their skins, save dripping, and avoid waste of all kind, as well as to cook by the War Cookery Book (Kriegs-Kochbuch), a pamphlet issued by one of the authors of this book on the lines it lays down. These and other facts, such as the eminence of its authors, make it difficult to avoid the conclusion that in the volume before us we have the text-book on which the German Government and people are acting.

Incidentally, the volume is a mine of information on many vital aspects of German life during the war, commercial, industrial, agricultural, economic, and domestic, and therefore affords an invaluable guide as to the actual present condition of the country.

In conclusion, I wish to thank Miss H. V. Trust, of the central office of the University of London, for her valuable help in making the translation.

S. Russell Wells.

June, 1915.

INTRODUCTION

By AUGUSTUS D. WALLER

THE object of this memoir, prepared by a committee of distinguished German specialists, and published in December last under the editorship of Dr. Eltzbacher, was to recommend measures of economy in order to counteract what is known in Germany as the "English starvation policy." An excellent summary of the memoir was published in the *Lancet* for February 20th, 1915, but as far as my reading goes, does not seem to have attracted much attention in this country. Whereas we read in the *Norddeutsche Allgemeine Zeitung* that "No military success will avail to save Germany unless the menace of starvation is averted," we find F. T. Jane writing in *Land and Water* (February 27th) that "So far from shortening the duration of the war, I am inclined to think that an embargo on German foodstuff from overseas will lengthen the struggle. Consequently it may be our best policy to let the Germans get all the food they want, even if necessary spending money in seeing that their food is abundant." And in accordance with this philanthropic doctrine we have exported (in large part to Germany *viâ* Holland) during the months of war, from August, 1914, to May, 1915, inclusive, more than three times as much cocoa as during the corresponding ten months of the previous year. Our export of cocoa was at its maximum in December, 1914, viz., 7,232,806 lbs., as compared with 1,121,415 lbs. in December, 1913; the chief ultimate destination of this sixfold export was Germany. In May, 1915, the export amounted to 4,208,347 lbs., as compared with 1,423,901 lbs. in May, 1914; but I have not been able to trace the ultimate destination of this more recent increase.

This is an extreme view indeed. It ignores the obvious fact that the food of a besieged nation, as of a besieged fortress, in tons of bread, meat, and potatoes is as truly its ammunition as are its shells, and the policy it recommends seems on a par with that of the chivalrous combatant who should supply his enemy with ammunition in order to continue the fight.

It is well that we should think clearly and *arithmetically* in the matter, as is the habit of mind of our present enemy. Loose thinking in the matter of food-supply can easily lead to or permit loose commerce, and justify a laxness of which it is inconceivable that the German fighter should be capable. Germans assume as a matter of course the Allied blockade of German foodstuffs to be as stringent as possible; that is the policy they themselves would have adopted long since if they had possessed the power to do so—they are actually doing so to the best of their fortunately incomplete power by the under-sea method.

It is good for us to possess an accurate account of the policy they profess to expect from us, expressed in their own methodical fashion in terms of millions of tons of protein and billions of calories. The Berlin committee of statisticians and physiologists have drawn up a careful and exhaustive account of internal needs and internal resources, in which they prove to their own satisfaction that needs can be met by resources, and that, therefore, they are confident that the "Englische Aushungerungsplan" will be shattered.

They may be right or they may be wrong in their assumptions and estimates. I shall not hazard any opinion on this issue, but shall limit myself to re-stating quite briefly what appear to me to be the principal physiological data upon which their case is built, viz., the assets and expenditure (1) of protein, (2) of calories. But for any satisfactory judgment the German problem as it has presented itself to the German mind must be studied in the German text, of which the present volume contains the translation *in extenso*.

[*Protein, fat,* and *carbohydrate* are the three necessary substances contained in the foodstuffs *bread, meat, potatoes, beans,* etc. *Protein* is the most necessary and the most expensive of these three substances.]

PERCENTAGE COMPOSITION AND CALORIMETRIC VALUES OF SOME ORDINARY FOOD-STUFFS (FROM ZUNTZ'S TABLES).

	Water.	Protein.	Fat.	Carb. Hyd.	Calories per 100 gr.
Beef (medium fat) ...	72·5	21·0	5 5	—	137
Beef (lean)	76·4	20·7	1·7	—	101
Pork (fat)	47·4	14·5	37·3	—	406
Pork (lean)	72·6	20·3	6·8	—	146
Wheat	13·4	12·0	1·9	68·7	349
Wheat bread	33·7	6·8	0·5	57·8	270
Rye	13·3	11·2	1·7	69·4	346
Rye bread...	39·8	6·4	1·1	50·4	243
Potatoes	74·9	2·0	0·1	20·9	95
Eggs	73·6	12·6	12·1	0·6	167
Cow's Milk	87·5	3·4	3·6	4·8	67
Dutch Cheese	36·6	25·7	29·0	3·5	389
Butter	13·5	0·7	83·7	0·5	783
Oats	12·8	13·5	7·6	62·8	384
Barley	13·0	9·7	1·9	68·5	338
Rice	13·2	8.1	1·3	75·5	355
Maize	13·3	9·6	5·1	67·9	365
Peas	13·6	23·4	1·9	52·7	330
Beans	13·9	25·7	1·7	47·3	315

The essential data and conclusions of the memoir are tabulated on pages 73 to 75 [62–3], page 79 [66], and page 230[1] [194]. They can be summarised as follows:—

I. Germany used during the years 1912 and 1913 two and a quarter million tons of protein food per annum . . . 2,261,900 tons.[2]

II. Germany can with care live upon a smaller amount, viz., rather more than a million and a half tons . . . . . 1,605,000 tons.

III. The internal resources of Germany cut off from any imports will nearly meet this reduced need, producing slightly more than a million and a half tons . . . . 1,554,000 tons.

IV. The internal resources of Germany can be increased by strict economy to two million tons . . . 2,022,800 tons.

Or, translating millions of tons into terms that appeal more directly to the physiologist and to the actual consumer, this message of the German professors to the German people is as follows:—

I. You consumed protein during the two years before the war at the rate of 116 grammes per man per day (or 93 grammes per head of the population per day).

II. Your minimum physiological requirement is 80 grammes per man per day (or 64 grammes per head per day).

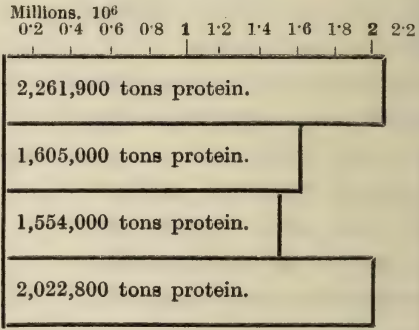
III. You are producing at home 78 grammes per man per day (or 62·5 grammes per head per day).

---

[1] Corresponding pages in the original German are given in square brackets.

[2] 2,261,900 tons for a population of 66·7 millions; *i.e.*, 2,307,000 tons for a population of 68 millions.

IV. Therefore you must economise and increase your home-production, which can be raised to 102 grammes per man per day (or 81·5 grammes per head per day).



August to August.		Grammes per head per day.	Grammes per man per day.
I. You consumed at the rate of .	2,261,900 tons protein.	93	116
II. You require for 1914–15	1,605,000 tons protein.	64	80
III. You are producing for 1914–15. .	1,554,000 tons protein.	62·5	78
IV. You can produce for 1914–15. .	2,022,800 tons protein.	81·5	102

Total protein assets of the German nation as stated by the German committee.

The "ton" is here the metric ton = 1,000 kilos. = about 2,200 lbs.

The food-supply of a population is estimated per head or per man, "man" being taken as the unit. Thus for the year 1911, the population of Germany being 65 millions men, women and children, can be reduced as follows to number of men :—

19 million men = 19 millon men
20 million women = 18 million men
26 million children = 13 million men
— —
65 million men, women, and children = 50 million "men."

In other words, nine men are supposed to require as much food as ten women, and two children as much as one man. Thus the "man value" of a mixed population of 65 millions may be taken as 50 millions In the German text this value is not always taken the same. Thus at p. 29 [24] it is taken as $\frac{49543889}{64992238}$ or 0·7625 of the population reckoned as unity. And at p. 37 [32] it is taken as $\frac{52536280}{64992238}$ or 0·8085 of the population. This discrepancy is due to the fact that in this table the proteid requirement of children has been rated high. For all ordinary calculations we may take the "man value" of a population as 80 per cent. of the total number of men + women + children, *e.g.*, a city of 100,000 inhabitants may be considered as having a man value of 80,000. Thus food *per head* must be multiplied by $\frac{10}{8}$ to give food per man; food per man must be multiplied by $\frac{8}{10}$ to give food per head.

It is important to realise which of these scales is meant when amounts are stated per head of the population. Thus on page 75 [63] the average daily amount of protein consumed for 1912 and 1913 is given as 92·9 grammes, which is a very reasonable amount per head, but rather a small amount per man. The Berlin committee takes the smaller number per head for its statement of what has been consumed in previous years, whereas for its statement of the minimum amount required during the first war-year it gives the minimum protein requirement per man as 80 grammes.

Therefore in the tabulated summary of the German statement just given I have thought it best for the sake of clearness to give the estimates on both scales per head as well as per man, when it will be recognised that the German position as stated by the German committee is not quite as favourable as it appears at the first reading.[1]

It reads in the text: "You had 92·9 grammes in 1912–13 p. 75 [63], you need 80 grammes for 1914–15 p. 35 [30]."

It says in reality: "You had 116 grammes per man in 1912–13, you need 80 grammes per man for 1914–15; or, you had 93 grammes per head in 1912–13, you need 64 grammes per head for 1914–15."

To a physiologist the estimate of 80 gr. protein per man per day, which is Zuntz's well-known minimum figure (*Lehrbuch der Physiologie der Menschen,* 1909, p. 707) must appear decidedly low. Even lower figures have indeed been recommended by Chittenden, 60 gr. and less, but most authorities give decidedly higher figures; thus in Voit's well-known mean standard diet the protein allowance is put at 118 gr.; in the *ante bellum* estimates given by Rubner, who is the leading medical member of the Berlin committee, the mean figure

---

[1] I have not taken into consideration the varying proportion in which protein of various sources is actually utilised. It has been shown by Rubner more especially that protein in meat is more completely absorbed than protein in bread. The waste per 100 of the former is only about 2·5; that of the latter may be put at 25. In the following diet the loss per 100 comes out as:—

	Grams (about).	Protein Swallowed.	(Per cent. loss).	Protein lost.	Protein Absorbed.
1-lb. Bread	450	36	(25)	9	27·0
½-lb. Meat	225	44	(2·5)	1·1	42·9
¼-lb. Fat	125	—	—	—	—
1-lb. Potatoes	450	9	(33)	3	6·0
½-pint Milk	300	12	(10)	1·2	10·8
2 Eggs	100	14	(2·5)	0·35	13·6
2-oz. Cheese	60	21	(2·5)	0·525	20·475
		136	—	15·175	120·775

Thus of the 136 grammes *swallowed* 121 grammes are absorbed —*i.e.,* there is a loss amounting to 12 per cent.

is 127 gr. in 1903 (von Leyden's *Handbuch der Ernährungstherapie*, 1903, Vol. I., p. 150) and 118 gr. in 1907 (*i.e.*, he adopts Voit's figure [Rubner's *Lehrbuch der Hygiene*, 1907, p. 150.]) If the Berlin committee had estimated on the basis of 100 gr. protein per man per day instead of 80, their figure of 1,605,000 tons as the minimum protein requirement for 1914–15 would have been raised to two million tons. Moreover, the estimates of actual production (1,554,000 tons) and of maximum possible production (2,022,800 tons) for 1914–15, are based upon the harvest returns of the two previous years, 1912 and 1913, which are considerably above the average of the ten previous years.[1]

I find it difficult to defend myself from the impression that the Berlin physiologists have assumed a protein allowance which is rather low for the German consumer; 80 grammes per man might, indeed, be found to be adequate in a physiological experiment of short duration under conditions of perfect economy, but it would scarcely seem to afford a safe prospect to a hermetically besieged nation as contemplated by the Berlin Committee; the allowance would almost certainly require to be supplemented by imported protein.

The German problem, from the German standpoint, gives a more satisfactory conclusion when it is stated in terms of the total energy value of the food-supply, *i.e.*, in calories. The energy of the protein, fat, and carbohydrate in bread, meat, and potatoes is calculated from the follow-

---

[1] The official returns of the Rye and Wheat crops for the ten years 1904–13 are as follows in millions of tons :—

	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	Average
Rye ...	10	9·6	9·6	9·7	10·7	11·3	10·5	10·8	11·5	12·2	10·59
Wheat...	3·8	3·6	3·9	3·4	3·7	3·7	3·8	4·0	4·3	4·6	3·88

The estimates adopted in the pamphlet (page 34) are :—Rye, 11·9 ; Wheat, 4·5.

ing values: 1 gramme of protein or of carbohydrate in food is equivalent to 4·1 calories, 1 gramme of fat to 9·3 calories. The ordinary total to which it is considered that the energy value of the day's food should reach is 3,000 calories per man.

The total calorimetric values per annum as stated by the Berlin committee are as follows:—

I. With a population of 66·67 million heads (men, women, and children) you used for 1913 88·65 billion calories, *i.e.*, you would have used, with a population of 68 millions for 1914, 90·42 billion calories.

II. Your minimum physiological requirement is 56·75 billion calories.

III. You should produce at home normally 71·24 billion calories, or allowing for abnormal conditions a fall in production of 5 per cent., say, 67·68 billion calories.

IV. You can by extraordinary measures of economy raise your home production to 81·25 billion calories.

These figures, 90·42, 56·75, 67·68, and 81·25 billions, reduced to values per head per day come out as follows:—

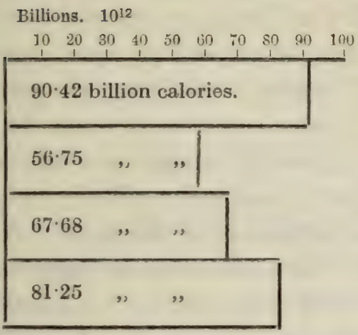
I. You used for 1913–14 4,779 cals. per man per day.

II. You require for 1915–16 3,000 cals. per man per day.

III. You will have at home for 1915–16 3,577 cals. per man per day.

IV. You *can* have at home for 1915–16 4,295 cals. per man per day.

Therefore you will pull through in spite of the British attempt to outhunger you.



	Calories per head per day.	Calories per man per day.
I. You used for 1913–14 ...	3642	4779
II. You require for 1914–15 ...	2287	3000
III. You will have for 1914–15 .	2727	3577
IV. You can have for 1914–15 .	3274	4295

Total energy assets (in calories) of the German nation as stated by the German committee.

N.B.—The figure 90·42 in Column I. makes allowance for an increase of population to 68 millions from 66⅗ millions, with the actual figure 88,649 milliards, p. 74 [62].

The figure 67·68 in Column III. makes allowance for a reduction of the actual figure 71,237 milliards by 5%, p. 79 [66].

1 milliard = 1,000 millions, *i.e.*, 1,000,000,000 or 10^9.

1 billion = 1 million millions, *i.e.*, 1,000,000,000,000 or 10^{12}.

The "man value" used in this table is 0·7625, p. 29 [25].

On this showing the German argument in terms of calories appears considerably more promising than the argument in terms of protein. The total energy values required and available stated in terms of calories show no danger of starvation. But this satisfactory outlook depends almost entirely upon the supply of the less valuable but more abundant carbohydrate afforded by potatoes and by beetroot. And even in respect of calories the validity of statements III. and IV. rests upon the validity of previous official returns and of the estimated raising of production from 67·68 to 81·25 billion calories attainable by the measures of economy that are tabulated on page 230 [194] and discussed at length in the preceding Chapters V. to X. Any attempt to summarise or evaluate the separate details by which the total economy of half a million tons of proteid and upwards of 13 billion calories is arrived at could serve no useful purpose. Each reader must form his own opinion as regards the particular items with which he may be conversant. To the average reader the most useful purpose the whole pamphlet can serve will be to convince him of German completeness of method. A smile may perhaps come to his relief when he finds included in the account of available meat supply 100 tons of dog, p. 57 [48]; in contrast with the supply of pigs of over two millions tons the amount might have been regarded as negligible.

There are many indications that the Berlin committee is making a *bona fide* endeavour to instruct and guide German domestic economy through a difficult pass. Their report is best studied on that assumption. It deals exclusively with the needs and resources of Germany proper, not with those of Austria-Hungary, and as regards the former it expressly omits from the account any reserve stores of food, fodder, and manure, p.18 [16], formed before the war, and any possible steps taken during its early months to cover the recognised deficit. And they have further allowed for the probable diminution of their future resources by allowing for a decrease of 5 per cent. instead of a normal increase of 2 per cent. in the food-production of the country. They have not given any evaluation whatever of the probable leakage of blockade, but have estimated as if for a hermetic siege. And it is obvious that for a siege on such a scale leakage must be the great disturbing factor. A practically hermetic siege as in the case of Paris in 1870–71 cannot be assumed.

But signs are not wanting that even the imperfect limitation of food-supply brought about by the state of war is producing upon the health and strength of Germany some portion of the effect that was to be anticipated.

According to the moderate phraseology of the United States, "a course of action previously unknown to international law" is being pursued. The phrase is applied to England's "long-range blockade" of Germany, by which, according to German professions, an effort is being made to starve a nation containing 35 million women and children.[1] The phrase is wholly inadequate to characterise Germany's short-range concealed blockade of England, whereby an effort is made to starve a nation that also contains women and children, but where, according to Count Reventlow, "by reason of the narrow range of vision of the submarine through its periscope and the danger of showing itself on the surface of the water it is unfortunately not always possible to delay sinking a merchant ship without warning," and incidentally put to death many men, women, and children. Such action is assuredly "previously unknown to international law," but so far from giving proof of formidable strength, it is the clearest possible evidence of desperate weakness; to use the language of the *Philadelphia Public Ledger*, "it reveals Germany in the attitude of a frenzied beast at bay."

In this account given by the Berlin professors in

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[1] According to the *Times* of June 7th, Dr. Delbrück on June 5th informed the Prussian Diet that the food question might be regarded as solved, the stock of flour showing a surplus of nearly 700,000 tons. Last month the surplus was stated as being 200,000 tons. The average monthly requirement of Germany in normal times is about one million tons.

December, 1914, of the measures by which the so-called "hunger war" of Great Britain against Germany can be defeated, the hypothetical conclusion is drawn that *if* measures of economy are adopted Germany cannot be starved out.

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June, 1915.

GERMANY'S FOOD AND ENGLAND'S PLAN TO STARVE HER OUT

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German Original published in Brunswick, December, 1914.

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GERMAN PREFACE

When, on the 4th of August, England declared war on Germany, a question forced itself upon the attention of everyone who had intimate knowledge of our economic life. Could we hold out through a very long war if we were cut off from our considerable imports of food and fodder? To me the question took this form: What can we do? Can we, by a well thought-out change in our production of food and way of living, become independent of the foreigner for any length of time—a self-supporting country? But even as I put this question to myself I fully realised how impossible it was for any one person to answer it exactly and thoroughly.

Human knowledge is constantly growing, and to-day we seem doomed to one of two evils—either a narrow, barren specialisation, or a superficial omniscience. One means of escaping both these pitfalls is collaboration—not the only too common sort of collaboration, where representatives of different professions divide a number of questions among themselves for separate study, for this leads in the end only to greater specialisation; but a real collaboration and co-operation, where each discusses the points of view of the others, until they are fused into one homogeneous whole and at last a work appears which seems to have been written by one man combining the knowledge of all. Though little attention has hitherto been paid to such joint work, it accords with the spirit of our times, and is a method well fitted to bring the great problems of our social life nearer their solution.

The question of the nation's food during war is such a problem, requiring, if it is to be fully understood and worked out exactly, the aid of the politician, the political economist, the statistician, the physiologist, the farmer, the geologist, and even the experienced housekeeper. I have been fortunate in gathering a circle of collaborators, representatives of different professions, alike in their complete mastery of the subjects respectively entrusted to them and in their enthusiastic devotion to the common task. For many weeks we each worked alone, holding numerous conferences; we realised more and more the difficulties of the problem, but at the same time we realised how the joint work was bringing us nearer to their solution.

We can nearly all vouch for one result. Before the work was begun and also during our labours there were many differences of opinion among us; but we learnt from each other, and now we are agreed on all essential points.

Over four months have been spent on the work. We are conscious that every day on which we could have completed it earlier would have been a gain. In order to compensate to some extent for its late appearance we have tried, during its progress, and so far as results were to hand, to further its aims by instructing the public and by laying proposals before the authorities. We have frequently met with success; above all, we believe we may claim some credit for the withdrawal of the extensive permission to export sugar.

Two conclusions may be drawn from our work—that Germany with proper care is unconquerable even with regard to her food supply, but that the gravity of the situation makes the greatest demands on every German and especially on the authorities. Our work will only attain its object if it helps to ensure that the success of our arms is not brought to naught by economic shortcomings.

ELTZBACHER.

GRUNEWALD, BERLIN, *12th December*, 1914.

GERMANY'S FOOD

CHAPTER I

The Political Economy of an Isolated State

1. *The English Scheme to Starve Us Out*

The present world war is being waged with weapons which were unknown to any earlier age. Economic weapons have been added to military means of annihilation. In the forefront stands a scheme from which our opponents hoped great things even before the war, and which is now, after a succession of fearful defeats, doubly important to them. It is the famous starvation scheme. Our flourishing economic life has brought us into the closest connection with every country, and it is apparently only this connection which has enabled us to feed the ever-increasing population within our narrow borders; now our enemies desire to seal us hermetically from the outside world and to tie the veins of our economic life. Our army and fleet having shown themselves a match for half the world, our nation is to be conquered by hunger.

Germany and Austria are for the most part surrounded by hostile countries, the only neutral frontiers being those of Holland, Denmark, Switzerland, Italy, and Roumania. By means of a so-called command of the sea and by influencing our neutral neighbours it is hoped to cut off Germany and Austria from the rest of the world and so force them to their knees. Our enemies suppose that Germany and Austria cannot exist for any length of time without their enormous foreign trade, which in 1913 amounted to 21 milliards of marks (£1,050,000,000) for Germany and to 5 milliards (£250,000,000) for Austria. While much is hoped from tying up the export trade, greater results are expected from hindering the importation of all that we need for manufacture and daily life—wool, cotton, petroleum, copper, and the like, but, above all, food for man and beast. It is believed that we should find it difficult to hold out for any length of time without our exports—and quite impossible without our imports. This plan of campaign was originated by England, who, in her ruthless desire for power, has never hesitated to countenance the use of any weapon, and in her colonial wars has quite forgotten how to fight decently. The concentration camps of the Boer War afford the latest proof that the English gentleman is not ashamed to make war against women and children; now England desires to use this well-tried weapon on a large scale, and would like to make the whole of Germany one vast concentration camp. France, corrupted by her English alliance, has taken up the starvation idea with rapture, though it is little worthy of so chivalrous a nation.

Even before the war the plan was frequently referred to—for instance, Emile Chautemps spoke of it quite openly in the French Senate in June of this year. After our victories these references became more numerous. At the end of August, Charles Richet, the famous physiologist and apostle of peace, wrote in the *Figaro* that before nine months were out Germany would be on her knees and begging for peace, if, indeed, hunger had not made her speechless.

What is in the Englishman's heart does not spring to his lips as it does with the Frenchman, but deeds speak more plainly than words. The English fleet takes care not to attack ours, but strives to impede our trade in every way. Though it is contrary to all modern idea of right, England has stubbornly refused to accede to the demands of the other Powers that she should respect the defencelessness of enemy private property at sea, and now her fleet's most enlightened task consists in crippling German merchant shipping. Even neutral shipping which could contribute to our support is hindered in every way. For instance, England has decreed that all merchant ships of neutral Powers which leave an English port for a neutral harbour must deposit security amounting to three times the value of the cargo. To the same end, pressure is being brought to bear on our neutral neighbours. In August, England made a definite suggestion to the northern countries that they should forbid the export of food-stuffs to Germany; we have only to thank the good feeling of those countries that the suggestion was not adopted. Since then England has sought in every way to cut off Germany from the rest of the world by hindering regular neutral commerce. "Germany is about to lose for ten years or more not only the great markets of Russia, France, and Belgium," writes the London newspaper, the *Financier*, "but those of the whole English-speaking race. German foreign trade has suddenly ceased, and it is for us to see that it never revives. What Germany has won by long and painful toil is suddenly given into our hands. So long as we command the great ocean trade-routes, and provided we make full use of the opportunity, the complaint of German commercial competition will not be heard again." The English Government is working energetically for this idea; for instance, it has started in London an exhibition of specimens of German goods, showing the amount of sales, the price, and everything else which may help the English to seize the manufacture and sale of these goods for themselves. England carries on the war chiefly on economic fields, and sees in the starvation of Germany her best means of winning.

2. *Germany as an Isolated State*

It is clear that the starvation scheme exists, and equally clear that our enemies see in it their most powerful weapon against us. We can strike it out of their hands, but only if we look the situation calmly in the face. What we have to do is obvious. We must protect our imports by every military and diplomatic means at our command, but above all we must be prepared to manage without those imports. Germany and Austria must begin to live if need be, and for as long as necessary, as one isolated State.

In common with Austria, we must equip ourselves for such an existence, cut off from the rest of the world, since in an economic as well as in a military sense we are bound to Austria for weal or woe. It would be of the gravest danger to us if Austria should lay down her arms, but it would be equally ominous if she were economically ruined. This danger is, of course, far less for Austria than for us, for with her smaller population, and the greater *rôle* played by agriculture in her economic life, she can more easily renounce her imports from abroad. This is clearly shown by the fact that the population of Austria is about four-fifths of the population of the German Empire, while her foreign trade amounts only to about one-quarter of Germany's. Germany's foreign trade in proportion to the population is three times as great as that of Austria. So that if we must both prepare for an isolated economic life we need have no fear for Austria. It is Germany who will be most seriously endangered by being cut off from the rest of the world, and she must take measures accordingly.

We ought not to build any hopes on the foreign countries with which we are still on friendly terms, and no more on the occupied portions of Belgium and Poland than on the Netherlands, Scandinavia, Switzerland, Italy, and Roumania. We do not know with sufficient certainty what the occupied districts so hardly won in war can furnish without exposing the population to the risk of famine. News has already arrived that in Liège and other Belgian towns there is a general scarcity of provisions, and that the German administration has been obliged to send them grain. We also do not know how long the present neutral countries will remain neutral, or whether they may not be compelled sooner or later by diplomatic or economic necessity to forbid export. Such prohibitions of export have already been issued; for instance, Denmark very soon found herself obliged to forbid the export of barley, which she needs for the maintenance of her cattle breeding. News is continually being received, now confirmed and now denied, in regard to prohibitions of export in Holland and Roumania, plainly showing on what an insecure foundation our trade with neutral countries rests.

We must prepare, together with Austria, for a long period of isolated economic existence. England's special object is to crush our foreign trade, and she hopes to attain that object the more thoroughly the longer the war lasts. Trusting to her insular seclusion, and because she carries on the war by means of a paid mercenary army, she has little to fear from a long war. With her cold business sense, she brought about and began the war, and apparently considers she has more to gain than to lose from a protracted one.

It is quite possible that the English calculation is a mistaken one. English shipping is being disturbed and disquieted by our fleet, English industry has lost enormous sales, so long as the war with its best customer lasts, and certain trades are in want of important materials—for instance, the textile trade needs the German dyes. England's carrying trade, a particularly remunerative part of English commerce, is seriously damaged. It is, therefore, not surprising that unemployment is the rule in England, and that the first result of the economic war was to upset the English money market.

It is quite possible that a protracted war would become intolerable to England herself, but it would be dangerous to count on a short war for that reason. England has shown her extraordinary tenacity on more than one occasion; for example, in the war with Napoleon and also in the Boer War. After the first French defeats, an agreement was made, under English pressure, by which England, France, and Russia mutually bound themselves not to make a separate peace, an agreement founded in all probability on England's desire to continue the war with the help of her fleet as an economic war, even after the French have been beaten on land.

It was probably no mere figure of speech when Lord Kitchener declared in the House of Lords that the war would be carried on however long it lasted, and when Asquith said that the war would be continued if necessary for twenty years.

The German party leaders clearly understood the state of affairs when, soon after the beginning of the war, they declared themselves unanimously in favour of a rapid and large increase in our navy. The war will only be won when continuing it offers no prospect to our opponents, so our navy must become not weaker, but stronger, and our economic life equal to a war of anv length. Then perhaps the war may be short, for our opponents will see that we can beat them in determination as in so many other ways. The best means of shortening the war is to be prepared for a long one.

3. *The Problem of Isolated Political Economy*

While Germany, in common with Austria, prepares to meet, for years if necessary, the starvation scheme of her opponents by building up an economic state cut off from the rest of the world, a new problem presents itself to the political economist and the statesman—that of the political economy of the isolated German nation.

Not so very long ago it was thought that two new branches of learning should be placed beside political economy—world economics and special economics. World economics investigates the relations of various national political economies to each other rather than the political economy of a single nation; special economics, on the other hand, deals with the separate economies which make up every national economy, the agricultural, the industrial, and the commercial. World and special economics became so much the fashion that national political economy seemed almost in the background.

Now a situation has arisen in which we must remind ourselves that between world and special economics stands the political economy of our nation. Among the great acquisitions for which we have to thank the war, perhaps the greatest is that it has put new life into our national consciousness. Two dangers threatened us: love of everything foreign (or internationalism), and personal egotism (or individualism). In the most diverse paths of life, in art, literature, fashion, German characteristics seemed either to be forgotten in the general admiration of the foreigner, or to have lost all coherence in the strife for self-assertion. The war has changed all this. With our whole hearts we feel ourselves to be Germans. The cults of the foreigner and egotism have fallen from us as if they were unfitted to us. Each sees his highest aim in serving the Fatherland to the best of his ability, and it now seems absolutely natural that world connections as well as private interests should be placed in the background of our economic life, and that we should think only of the economic weal of the German people. Should circumstances compel Germany and Austria to become one isolated State, each one of us will adapt his thought and deeds to the necessity without further ado.

In an isolated State, economic thought experiences a complete transformation. So long as our national economic life was bound up with that of the rest of the world, the idea of production stood in the foreground; if we produced valuable goods no matter of how one-sided a nature, no one doubted the possibility of exchanging them abroad for all that we needed in our daily life. But now, in our isolation, the idea of consumption has become the issue of economic thought; we have to ask ourselves what we need for our nourishment, clothing, warmth, and so on, and set about producing it. This change has made itself felt everywhere. For instance, we have a number of unemployed, although labourers are wanted on the farms and in other important industries which supply our national needs. Formerly, perhaps, the problem of unemployment was the more pressing, but now removing the scarcity of labour in those industries is far more urgent. Further, it is proposed to start many industries which cannot be lastingly profitable, such as the drying of potatoes or the production of nitrogenous manure. Formerly, we should have scorned such enterprises; now it seems quite natural that they should be established without regard to profit.

So long as our economic life was bound up with that of the rest of the world, great personal freedom in our economic demeanour was possible. Even those who had given up the principle of boundless *laisser faire* still feared any far-reaching restrictions of economic freedom; but in the difficult position which has arisen through the sudden isolation of German economic life that fear must disappear. Our economic life is subject to State regulation to an extent hitherto unheard of. The Federal Council has extensive powers to prohibit the export or fix the highest prices of objects of daily necessity, and they can also demand any restriction of economic freedom which the situation may require. Patriotic feeling has, however, accepted this far-reaching

State regulation as absolutely justified. Nowadays everyone is a Socialist, so to speak.

How can Germany exist economically under totally different conditions as an isolated State? How far, with due regard to Austria, can she meet her needs from her own production? This question has got to be answered. Pessimism is as much to be avoided as optimism, but caution is certainly necessary. We have not only to reckon with the vagaries of weather, but also with the fact that the dearth of skilled labour, of horses, and of manures must injure our next harvests.

Only one part of the question that has been raised will be discussed in the following pages, but that part is by far the most important one—the nation's food. How can Germany manage without the food at present imported from abroad and without the imported materials which are used in the production of food? The problem is not only of theoretical interest, but of the very greatest practical importance, for it concerns nothing less than the outcome of the war. The efficiency of our army, our transport service, and our finances has been brilliantly proved. If we wish to win, the organisation of food supplies must not be lacking.

CHAPTER II

The Decrease in Food-stuffs

1. *Decreased Imports*

Various facts oblige us to reckon with a decrease in the amount of food supplies at our disposal during the war. We must look these facts in the face, for only in this way can we make them inoperative and so frustrate the plans which our opponents have built on them. We must be prepared for a considerable decrease in oversea imports of food-stuff and fodder and of such materials as we use in the manufacture of food, for instance, barley for brewing purposes, a decrease in direct imports to German and Austrian harbours, as well as in indirect imports through neutral States. What immense quantities are concerned is clear when we realise that up to the present time ten million tons more of farm, garden and field produce alone have been annually imported than exported.

We may, of course, hope that imports across the Baltic will remain. The Baltic is commanded by our fleet, and since the beginning of the war trade has continued without hindrance.

We must not, however, count in the same degree on continued imports across other seas. In consequence of the danger from mines, trade across the North Sea has almost entirely ceased, and trade by way of the neighbouring neutral States is not satisfactorily assured. The supply of foreign foods through Norway and Italy is hampered by the great distances on land and the small capacities of the railways concerned, most of which are single tracks. But the whole of our foreign trade, even with Holland and Denmark, may be wrecked by England's declaring contraband all such articles as are necessary for food. Contraband goods are liable to seizure by the enemy even if carried in neutral ships. According to current international law, contraband goods are not only instruments of war, such as weapons, projectiles, and armour plate (absolute contraband), but also every article which serves a peaceful end, but which in a particular case is destined for an enemy army or Government (relative contraband). Warring States have a wide licence in declaring and confiscating all kinds of articles as relative contraband.

The Declaration of London of 1909 in regard to the marine law of war does indeed restrict this licence. Articles 28, 29, and 35 provide that certain things cannot be declared contraband; for instance, oil-yielding nuts and seeds, copra, natural and artificial manure, including nitrates and phosphates used in agriculture. Moreover, according to this Declaration, articles of relative contraband are not liable to confiscation if, instead of going direct to an enemy country, they go only to a neutral harbour (for example, Rotterdam or Genoa). But England has not yet ratified the Declaration of London, and has not up to the present allowed consideration for the United States of America and other neutral countries to restrain her from shamelessly stretching the meaning of contraband.

The President of the United States of America made it known during the first days of October that England would lay an embargo on all kinds of food-stuff sent to Holland, Denmark, Sweden, and Norway unless the Governments of those countries could give the required assurance that the cargoes would not go to Germany. We should therefore do well, while attempting to import food and fodder, particularly through Holland, not to reckon on such imports as a certainty.

We must further be prepared for a considerable decrease or complete stoppage in the import of such food and fodder as are produced by our neutral neighbours. Not only may English diplomatic or economic pressure, such as has already been tried more than once, restrict the trade with these States, but this trade may, and indeed has, decreased considerably on account of their economic position and the influence of the war on that position.

Till now considerable quantities of animal food-stuffs (meat, butter, cheese, fish) have come from Holland. Holland can only feed about a third of her dense population from the food and fodder which she herself produces. She is only able to export these articles because she also imports considerable quantities of grain, bran, and oilcakes (excess of imports over exports in these goods is about 2 million tons). It is improbable that this import can take place to anything like the same extent during the war, for the war has seriously crippled merchant shipping. The export to Germany which depends on this import has therefore become doubtful, as is clearly shown by the latest Dutch prohibition to export food.

Far greater quantities of animal food-stuffs reach us in times of peace from Denmark (cattle, meat, cream, butter). But Denmark is a country of agricultural improvement schemes, and her export of animal products is absolutely conditional on the import of three-quarters to one million tons of grain and fodder. During the war this import must be uncertain, not only on account of the general hindrance to shipping, but more especially because of the mines in the North Sea. We must therefore expect a big drop in the Danish export of animal food-stuffs.

From Sweden and Norway we received only quite insignificant amounts of food and fodder (from Norway about one-fifth of the imported herrings). These countries are only able to meet their own needs with the help of imports. Sweden produces only three-quarters to four-fifths, Norway only one-eighth, of the grain they need for bread, and the production of animal food-stuffs in both countries barely exceeds their own needs; therefore we must not count on these countries to help us with their products to any considerable extent. Isolated cases of forwarding cattle to which reference is occasionally made in the Press are of no importance in comparison with our total needs.

Switzerland, that densely populated industrial country, only supplies us with a somewhat unimportant amount of cheese. She has to rely, not only upon an import of three-quarters to one million tons of grain and fodder, but also upon a not inconsiderable import of animal food-stuffs. During the war she will not be able to spare anything for us.

From Italy we have only imported quite a small amount of food (principally fruit, and about 3 per cent. of our import of eggs). Italy is also to a large extent a grain-importing country (1½ million tons of wheat and maize), so that an import of Italian food-stuffs cannot be taken into account.

Roumania is a food-exporting country. In ordinary years her chief export is from 1½ to 2 million tons of grain, but this year the Roumanian as well as the Hungarian harvests are said to be below the average, and the decreased quantity of grain which Roumania can furnish will therefore presumably all be absorbed by Austria. The pigs also which Roumania exports have probably been taken bv Austria. We are glad that Roumania has been able to help our ally with her food-stuffs, but for the present, at least, we cannot count on Roumania for our own support.

It is much to be hoped that the overseas imports and the imports from neighbouring countries will continue, as is now the case, to be at our disposal to a certain extent during the war; nevertheless, we should do well not to count on them, because the occupied districts may under the circumstances call for as much food from us as we receive in imports. Belgium is the most densely populated country in the world, and Russian Poland is also thickly populated. Instead of being able to count on supplies from these districts, now partially devastated by the war, we must rather be prepared to have to feed part of their populations.

The hope of imports from oversea or direct from neighbouring neutral States is therefore endangered by the fact that the occupied districts may use part of our food supply. If we wish to be cautious we should take neither contribution into account and should prepare to manage without imports.

2. *Decreased Home Production*

A further decrease in the food supplies at our disposal may quite possibly arise during the war from our home production being lessened, apart from the lack of foreign fodder and other auxiliary goods.

A decrease in home production has already begun in connection with fishing.

The average produce of the German fishery in the North Sea for the years 1912 and 1913 amounted to 142,000 tons and in the Baltic to 37,000 tons. In view of the risk of seizure of our ships by the enemy, and more particularly from the danger of mines, German North Sea fishing, above all the important deep sea fishing, shrank to an insignificant size at the beginning of the war and fishing in the Baltic has also diminished.

Thanks to the powerful activity of our navy, German fishery has already revived; nevertheless we should do well to count on a certain decrease in the home catch.

Of considerably greater importance than this deficiency is the possibility of a lessened yield from our agriculture during the war. It is quite possible that our next harvests may produce less than the harvests of peace, because of the dearth of skilled labour, and the lack of draught animals and manures.

A dearth of skilled agricultural labour arises from the fact that most of the farm hands are on the battlefield, and they cannot easily be replaced by industrial labourers, though this can be done at the harvest when the demand for skill and experience is far less. How far prisoners of war who are used to farm work could make up the deficiency is not yet certain; but if the ploughing and sowing is not properly done the harvest yield must be smaller.

A dearth of draught animals is due, not only to the fact that about half a million horses may be commandeered for the use of the army, but also because we can hardly count on our usual yearly import of 140,000 horses (chiefly from Russia). We shall, of course, be able to make up this deficiency to some extent by the employment of younger horses, by an increased use of cattle, and by a fuller use of existing motor ploughs and the installation of new ones; but whether the deficiency can be fully met in this way remains to be seen.

A dearth of manures also exists to a certain extent. In order that the present yield may be maintained our fields must have four kinds of fertilisers, varying with the constitution of the ground. These are potash, lime, phosphoric acid, and nitrogen. We possess more than enough potash and lime in Germany, in fact we are the greatest exporters of potash, but the supply of phosphoric acid and nitrogen is in danger.

Up to the present we have obtained the required amount of phosphoric acid mainly in two ways—first, from basic slag, a by-product of our home iron industry (about two million tons), which, ground fine, is used directly as manure; and secondly, by importing foreign phosphates (nearly one million tons) which for manuring purposes are treated with sulphuric acid and so made into about double the quantity of superphosphates. We have not only to allow for a decreased home production of basic slag owing to a falling off in the iron industry during the war, but also for smaller imports of phosphates and of the pyrites required in the preparation of sulphuric acid. The prohibition to export basic slag, and Belgian basic slag and Belgian raw phosphates will, of course, be some compensation; but it would be more provident to allow for a certain deficiency in sulphuric acid.

So far as nitrogen is concerned, we have supplied almost the whole of the amount required by the help of the ammonia gained as a by-product in our home coke manufacture and the saltpetre imported from Chili (half a million tons of each), with smaller quantities of artificial Norwegian saltpetre and nitrolin. But here too, we have to fear a shortage, especially in the particularly efficacious Chili saltpetre, and should there be a falling off in coke manufacture, in ammonia also. By using coke more freely we can, of course, increase our output of ammonia and we could manufacture large quantities of ammonia and especially of nitrolin in other ways; there is, however, as yet no evidence that sufficient precautions have been taken in this direction.

To these causes of a possible falling off in our agricultural production during the war must unfortunately be added the diminished yield of part of East Prussia and Alsace-Lorraine; part of the harvest there has been ruined by the war, and it is unlikely that the winter sowing has taken place to anything like the usual extent or with the usual care.

Thus there is a great possibility that our considerable imports of food-stuffs and raw materials needed for the home production of food-stuffs, may cease and that for the next few years our home production may also be reduced.

As a set-off to this, our attention has been freely called to our great stores of food, fodder, and manure. These stores, of course, do actually exist, but we should do better not to count on them. It is difficult to estimate their amount. In the first months of the war, when we did not properly grasp the situation, we certainly used more than we ought to have done. What remains we should therefore regard as a welcome reserve.

The probable decrease in our food-stuffs would be a matter of the gravest concern to us if we were not able to balance it by suitable economic measures. As a nation we are placed in the position of a man who has hitherto had a considerable income at his disposal and suddenly learns through misfortune that with careful housekeeping he can manage with much less.

CHAPTER III

FOOD REQUIREMENTS OF THE GERMAN NATION

1. *Purpose of Nourishment*

IN order to ascertain what the German nation needs in foodstuffs, we must begin with the reason for taking food. In order to make the matter clear, it is as well to keep to the well-worn comparison of the human organism with an engine. Even though this metaphor has certain deficiencies and defects, its main features are clear and illuminating.

Man is then a machine into whose furnace or cylinder materials are introduced which are there transformed by processes comparable to the burning of fuel. The chemical energy of the introduced materials is changed into the main activities of the machine man, namely, mechanical energy and heat. The only materials which can be taken into account as fuel for this human motor are those the chemical nature of which permits them to be absorbed by the intestinal canal after successful digestion, conveyed into the juices of the body, and carried by the blood to each cell of the tissue. There the final chemical change takes place, the oxidation (combustion) of the introduced food by the oxygen taken into the lungs from the air, a process which is allied to the change of chemical energy into mechanical energy and heat. In this respect the machine man differs only in minor details from other motors driven by chemical energy.

The following difference is however a substantial one. When a combustion engine, whether it is a steam engine or a petrol motor, gets worn out in the course of its work and shows signs of injury, the engine is stopped and the motor repaired. With the motor called man this procedure is not possible. He cannot be stopped, for a stoppage would mean death. Measures must therefore be taken in this case to repair the damages while the motor is actually working. This is the other function of nourishment. The living tissue is gradually worn away owing to the activities of the cells; whole cells age and die and are replaced by new cells, other cells themselves gradually renew their own substance. Some also excrete material which originates from their living substance and is expelled from the body. Thus continual losses are occurring, now from wear and tear, *e.g.*, of the external skin, scurf, nails, and hair, now by discharge from the body; *e.g.*, the excretion from the intestines. Compensation for these losses is made by the chemical transformation of the nutriment carried to the cells, out of which new living tissue is formed by the process called assimilation.

The supply of nourishment has therefore two aims which are theoretically completely diverse. On the one hand, it furnishes body-building materials, and so maintains the quality and quantity of the living tissue. This is covered by the so-called wear and tear quota of Rubner, which includes all the losses merely indicated above. In the young, still growing organism food has also to form a large additional quantity of living tissue. The other main object of the supply of nourishment is to provide materials the chemical energy of which will be changed into other energies, such as the muscular activity of the human body and the generation of heat. The question, therefore, is how to meet the energy expenditure of the human body by the supply of energy providers.

The part which the various foodstuffs play in these two great fundamental processes differs. Living tissue consists chiefly of protein, water, and salts; these substances are absolutely necessary for its maintenance. For all practical purposes we need only consider the supply of protein, since the supply of the necessary amount of water and salts does not demand any special precaution in our ordinary mixed diet. We must supply the body with as much protein for building purposes as it loses by regular wear and tear. A certain amount of protein is vitally necessary to the body.

Although protein is an absolute necessity to the organism as compensation for wear and tear, it does not, on the other hand, play any great part in the second object of the taking of nourishment, namely, in the production of energy. The qualitative character of the nutrients which act as energy-givers is considerably less important than the quantitative. Apart from secondary matters, only three great groups of nutrients, which are present in our daily food in varying degree, need be considered, namely, proteins, fats, and carbohydrates. If we compare these three groups numerically in respect to the resulting energy which they can give to the cells of the body by their physiological oxidation, expressing them in units of heat value, called calories (a calorie is the amount of heat which will raise 1 kilogram of water from 0° C. to 1° C.), 1 gram of fat furnishes about 9·3 calories, and 1 gram of carbohydrates and 1 gram of protein 4·1 calories each. Extensive experiments, more especially by Rubner, have conclusively proved that these figures actually represent the relative value of these nutrients to the activities of the body, and so far as the gain in energy is concerned, it is quite immaterial whether the body maintains its activities with carbohydrates, or fat, or protein. There thus appears a fact of extraordinarily great importance in the feeding of the nation, namely, that with regard to its properties as an energy-giver protein can claim no superiority over the other foods, and its value in this respect stands in no other relation to carbohydrates and fats than that expressed by its calorie figure.

The proteins, therefore, are indispensable only as building material; they have no special importance for driving "metabolism" where only the supply of the requisite amount of energy is concerned. It therefore follows that a supply of protein over and above that required for building metabolism can in general only be considered as a supply of energy-giver which could be replaced by fat and carbohydrates. If, therefore, the use of protein should have to be restricted on private or national economic grounds, the restriction would be harmless so long as the demands of the building metabolism were fully met.

Between the need for protein and the need for energy-givers there is a substantial difference. The protein requirement, the so-called hygienic protein minimum, for one man can to a certain extent be numerically fixed, since the consumption of protein remains practically unchanged by the greater or less amount of bodily work a man does. On the other hand, the need for energy-giving food is of varying magnitude, and depends on the amount of work which a man has to do. The figures for the need of energy-givers can therefore only be fixed, within certain limits up and down, when it is known about how much mechanical work the man does.

2. *Calorie Requirements*

We must now ascertain how great are the annual requirements of the German nation in calories.

The various foodstuffs, according to the available calories they contain, can fill each other's place in furthering the principal object of food-taking, *i.e.*, the supply of energy, so that if the amount of energy required by a man or a nation is known, we can say at once, quite apart from the nature of the foodstuffs, this man or this nation requires so many calories.

In speaking of the calorie requirements of a man or a people, we do not, however, mean only the calories necessary for the supply of energy which can be obtained from any nutrient, but also (in view of the impossibility of separation) the calories necessary for building purposes which must be furnished in the form of protein. As the building requirements can be met by relatively few calories, calorie requirements are principally energy requirements, and it is of energy requirements that we usually think when we speak of calorie requirements.

In meeting the calorie requirements, only that amount of energy which the body can make use of need be considered. We cannot make use of everything we eat; nearly all foodstuffs leave some residue in the solid excrement, and we speak of varying utility according to the amount of this residue. For instance, pumpernickel has very little utility, while meat has a great deal. If, therefore, we wish to know the value of any food to the body, we must find its utility and deduct the loss from the receipts; but with some foodstuffs, even what then remains is not all of value to the body. Fat and carbohydrates are digested without loss, but a considerable quantity of imperfectly digested protein is lost in the urine. The actual value of a foodstuff to the body after deduction of all losses is called pure calories. This is what is meant by saying that 1 gram of fat provides 9·3 calories, and that 1 gram of carbohydrate and 1 gram of protein each provide 4·1 calories.

The energy requirements of an organism depend on its activities. These are mechanical work, especially muscular work, and the production of heat. If the supply of energy corresponds to the activities, the organism is in equilibrium; if it is too little for the work, the organism gives up some of its store, especially of fat; if the supply is too great, the organism lays by a reserve store. Sufficient but not excessive nourishment is that which keeps the organism in equilibrium, that is, the supply of energy must correspond to the spending of energy.

The amount of a man's energy requirements has been shown by numerous researches. It depends on his work, but also on his size and weight. His energy requirements are greater when he is awake than when he is asleep, and of course still greater when he is walking, running, mountain climbing, or engaged in sport or labour. Exact measurements have been made by Zuntz, Rubner, Benedict, and others.

It also depends on what is called disposition. Apart from the greater activities of the body, a lively disposition needs a greater food consumption than a lethargic one; this is the case in youth; in old age the desire for activity is less. Measured on the same scale, people who weigh little have a greater energy consumption per kilogram[1] than those who weigh a great deal. It therefore seems almost impossible, in view of the multifarious activities of life, to fix any average values for energy requirements.

However, by statistical observation of the conditions in certain callings, ages, and ways of work, we have obtained data in regard to the need of pure calories. The results are supported and endorsed by scientific experiments of the most varied kind.

Experimental and statistical methods were used extensively about fifty years ago by Carl von Voit, in order to ascertain the amount of food required under varying conditions.

Later, on this basis, the following quantities were allowed as daily nourishment for a person weighing 70 kilograms and living on a mixed diet—for moderate work about 3,050 calories, and for hard work 3,575 calories. A similar estimate is made by Rubner; he allows for his work-category 1 (physician, light indoor employments) 2,445 calories, for category 2 (moderate work) 2,868 calories, for category 3 (heavy work) 3,362 calories, and for quite exceptional activities (Upper Bavarian lumberman) up to 6,100 calories. For many sports we can find even higher values, but as we are dealing here with the feeding of a mass of people, we need not take them into account. On the whole we should not make too low an estimate if we put the food requirements of a healthy, full-grown man at an average of 3,000 calories.

The food requirements of women and children need special consideration. The work done by women in civilised countries belongs generally to the category of light or moderate work. The calories required by needlewomen have been fixed at 2,000, by sewing machinists and bookbinders at 2,100 to 2,300, by domestic servants at 2,500 to 3,200, and by washerwomen at 2,900 to 3,700 calories.

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[1] 1 kilogram = 2 lbs. 3¼ ozs. avoirdupois, approximately.

Numerous researches and experiments have been made in regard to babies, children, and young people since 1890, when interest in the feeding of children and young people was first aroused. The figures thus obtained naturally vary considerably, according to age and sex. A baby can manage with a few hundred calories, while a girl of 14 years needs little less than a grown woman.

SCALE OF REQUIREMENT UNITS ACCORDING TO SEX AND AGE.

Age.	(1 grown man=100). Units according to										
	Engel.		Rubner.	Atwater.		Zuntz.		American Household		Danish statistics.	
	m. & f.		m. & f.	m. & f.		m. & f.		m. & f.		m.	f.
under 1 year	28·6		—	30		20		15		22	17·6
1	31·4		21·8	30		30		15		22	17 6
2	34·3		29·7	40		40		15		30	24·
3	37·1		35·4	40		40		15		36	28·8
4	40		38·8	40		40		40		39	31·2
5	42·9		42·3	40		50		40		43	34·4
6	45·7		43·7	50		50		40		44	35·2
7	48·6		45·0	50		50		75		45	36
8	51·4		46·4	50		50		75		47	37·6
9	54·3		47·8	50		50		75		48	38·4
10	57·1		49·2	60		75		75		50	40
11	60		54·4	60		75		90		55	44
12	62·9		59·6	60		75		90		60	48
13	65·7		65·0	60		75		90		66	52·8
14	68·6		70·6	80	70	75		90		71	56·8
15	71·4		73·1	80	70	100	80	100	90	74	59·2
16	74·3		75·7	80	70	100	80	100	90	76	60·8
17	77·1		78·4	80	70	100	80	100	90	79	63·2
18	80		81·6	100	80	100	80	100	90	82	65·6
19	82·9		100	100	80	100	80	100	90	100	80
20	85·7		100	100	80	100	80	100	90	100	80
21	88·6	85·7	100	100	80	100	80	100	90	100	80
22	91·4	85·7	100	100	80	100	80	100	90	100	80
23	94·3	85·7	100	100	80	100	80	100	90	100	80
24	97·1	85·7	100	100	80	100	80	100	90	100	80
25–29	100	85·7	100	100	80	100	80	100	90	100	80
60 & over	100	85·7	100	100	80	90	80	100	90	100	80

The most varied scales for the human requirements of nourishment according to age and sex appear in physiological and political economic literature. In the foregoing table five of the best-known scales are given, and also a new one by Zuntz. In these the requirement of a grown man under 60 is always given as 100.

In order to ascertain the total calories required by the German nation we must now convert the total population into requirement units (grown men under 60 years), and the means of doing so is offered by the calculations of the Imperial Statistics Office showing the total population on January 1, 1911, according to age and sex.

REQUIREMENT UNITS OF THE POPULATION OF GERMANY ON 1 JANUARY, 1911.

Age	Total Population.	Requirements according to					
		Engel.	Rubner.	Atwater.	Zuntz.	American Household Statistics.	Danish Household Statistics.
under 1 year	1,663,280	475,698	—	498,984	332,656	249,492	329,785
1	1,558,441	489,350	339,740	467,532	467,532	233,766	308,782
2	1,589,170	545,085	471,983	635,668	635,688	238,376	429,375
3	1,561,339	579,257	552,714	624,536	624,536	234,201	506,255
4	1,545,566	618,226	599,680	618,226	618,226	618,226	542,747
5	1,490,176	639,286	630,344	596,070	745,088	596,070	577,035
6	1,501,666	686,261	656,228	750,833	750,833	600,666	594,895
7	1,448,390	703,918	651,776	724,195	724,195	1,086,293	586,828
8	1,503,266	772,679	697,515	751,633	751,633	1,127,450	636,024
9	1,452,351	788,627	694,224	726,176	726,176	1,089,263	627,840
10	1,439,964	822,219	708,462	863,978	1,079,973	1,079,973	648,262
11	1,368,539	821,123	744,485	821,123	1,026,404	1,231,685	677,624
12	1,394,284	877,005	830,993	836,570	1,045,713	1,254,856	753,162
13	1,356,686	891,343	881,846	814,012	1,017,515	1,221,017	806,268
14	1,358,974	932,256	959,436	1,019,358	1,019,231	1,223,077	868,566
15	1,297,815	926,640	948,703	973,361	1,168,035	1,232,925	864,346
16	1,291,333	959,460	977,539	968,635	1,162,469	1,226,901	883,476
17	1,270,378	979,461	995,976	952,906	1,143,586	1,206,982	903,433
18	1,220,580	976,464	995,993	1,098,613	1,098,613	1,159,597	900,863
19 & over	37,680,040	34,552,919	37,680,040	33,816,315	33,590,700	35,748,178	33,816,315
Total	64,992,238	49,037,277	51,017,677	48,558,724	49,728,782	52,658,994	46,261,881

We therefore find that the amount of the present requirement units of a total population of 64,992,238 persons varies according to the scale which we apply between 46,261,881 and 52,658,994. On an average of all six scales it amounts to 49,543,889. Meanwhile up to the outbreak of war the population had increased to 68 millions, *i.e.*, by 4·6 per cent. If we raise the requirement units correspondingly by 4·6 per cent. we get 51,822,908.

On the basis of a daily requirement of 3,000 calories for a grown man under 60 years of age, the annual requirements of the German nation during the war are 3,000 calories × 365 × 51,822,908 = 56·75 billion calories.

3. *Protein Requirements*

We must now find what the protein requirements are for the German nation, that is, how great a part of its total requirement of nutriment expressed in calories must be supplied by protein. Just as we generally understand by the calorie requirements of a man his need of pure calories, so when we speak of protein requirements we always mean need of digestible protein.

A man's need of protein means nothing else than need of building material, and the necessity for a supply of protein only comes into consideration so far as it provides building material. In this particular, protein cannot be replaced by any other nutrient.

The peculiar significance of protein as the most important building material of the body is shown also in its chemical constitution. Even though we do not yet know all the details of the structure of the extraordinarily complicated organic compound of countless molecules which we summarise under the idea of protein bodies, we know at least that they differ considerably from the other nutrients. Its special importance is clearly shown by the greater number of chemical elements which compose it. While fats and carbohydrates contain only the elements carbon, hydrogen, and oxygen, the various kinds of protein contain in addition to these elements nitrogen and nearly always sulphur, many of them phosphorus as well, and some contain iron or other elements. The amount of nitrogen contained in protein varies very little and it is therefore possible by determining the amount of nitrogen contained in the food and in the solid excrement (which can be done easily and exactly) to ascertain the amount of protein absorbed by the body. The amount of protein decomposed in the body can be ascertained from the nitrogen contained in the urine. A comparison of the two amounts show a man's nitrogen balance. As a general rule, the nitrogen balance of grown men and animals who are receiving the same amount of nutriment does not swing far away from zero. This condition is known as the nitrogen equilibrium.

If we increase the supply of protein up to the limit it is possible to take, the excretion of nitrogen will at first be much less than the amount taken, but after a time, longer or shorter according to the individual's capacities for storing protein, the organism puts itself into nitrogen equilibrium again. The proteins supplied over and above the actual requirements for building do not build additional body tissue but provide energy which could be at least as well provided by other nutrients, *i.e.*, carbohydrates or fats.

If the supply of protein is decreased, the nitrogen balance is also reached, as a rule, after a certain time; this means, of course, that when the protein in the body has more or less decreased, the body reaches a low wear and tear quota (see p. 21) through the decrease in its cell material. The smallest supply of protein with which nitrogen equilibrium can be reached is called the physiological protein minimum.

The physiological protein minimum can be extraordinarily small. We know of experiments in which 17 grams of protein digested daily by grown men kept up the nitrogen equilibrium. However, such experiments are in general only of theoretical interest, for the organism cannot set itself in equilibrium with such minimum quantities of protein without being harmed in the long run.

Of far greater importance economically is the question of the so-called hygienic protein minimum, that is, the smallest quantity of protein which a man can take without harm to his constitution or to his activity. We have endeavoured to find out the hygienic protein minimum, and by experiments on individuals as well as on groups of men we have sought to ascertain the smallest amount of protein which will maintain the nitrogen equilibrium and at the same time cause no injury to health and strength. We found that the organism can adapt itself to the most unfavourable circumstances without suffering any obvious injury. Moderate underfeeding is by no means so dangerous as is generally believed. On the contrary, the ability of the organism to make up for, and even more than make up for, the damage done by temporary underfeeding is quite astounding.

The hygienic protein minimum, like the physiological, cannot easily be expressed by a fixed figure which will hold good under any conditions. To find the amount of protein which a man needs daily, many circumstances must be taken into account. First, the kind of protein. We call by the name of protein very different substances, which are not all of the same value. The protein in each foodstuff differs from that in every other in the details of its chemical constitution, and of course also from the kinds of proteins which build up our bodies and which we replace by taking food protein. The protein in different foodstuffs is therefore not all of the same value to the body as building material. The extent of the protein requirements is further influenced by the other constituents of the food, especially by the proportion in which carbohydrates and fats are present in it. A further important particular is the state of the body. In the same circumstances thin people need more protein than fat people. Body weight has, however, the greatest influence on a man's protein requirements.

Voit has allowed 104 to 106 grams of digestible protein for a man weighing 70 kilograms (as he was reckoning in crude protein he put it at 118 grams). This high figure is purposely chosen, because he believed that on the basis of a normal diet we could easily exceed our requirements and because we must above all see to it that there is no danger of too small a supply of protein; the figure represents the consumption of protein to be recommended rather than that vitally necessary. Another reason for the high figure is that Voit based it for the most part on statistical material from Munich, a town in which, as Rubner has pointed out, the consumption of protein in general, and the consumption of meat in particular, is unusually large.

In the meantime, statistical material has considerably increased. In 1902 Neumann made a summary of the literature, with the result that in the case of 144 out of 245 individuals (*i.e.*, 58·8 per cent.), and in the case of 37 out of 62 families or larger groups (*i.e.*, 59·7 per cent.), the supply of protein was below Voit's figure. An average of all 307 observations gives for a person weighing 70 kilograms a consumption of about 98 grams of digestible protein (109·7 grams crude protein); an average of the 181 cases in which the supply of protein was below Voit's standard, gives a consumption of about 71 grams digestible protein (80·2 grams crude protein). In 1913 Schumburg, after consideration of numerous later researches, came to the conclusion that most people in Germany and America can manage with 70 grams of digestible protein for moderate work.

Among experimental work of more recent date, the researches of the American, Chittenden, have attracted particular attention, because they were carried out on a large number of persons and extend as a rule over a period of three-quarters of a year. In these researches nitrogen equilibrium was attained with 50 to 60 grams of protein daily. The persons on whom the researches were carried out enjoyed good health during the whole period, although the protein contents of their bodies decreased. From this circumstance, and also for other reasons, it is to be feared that a supply of less than 60 grams daily would be harmful to many people, but it is reassuring to learn from these researches that numerous people lived for many months on such a small supply of protein without any obvious influence on their health and without any diminution in their bodily efficiency.

A grown man can therefore manage very well on an average of 70 grams of digestible protein without harm to his body. We arrive at a somewhat higher protein requirement, however, if we decide that it would be undesirable to make any great change in our usual mixed diet. This diet is generally very rich in protein, and therefore a healthy man who takes his required 3,000 calories in ordinary food necessarily consumes more than 70 grams of protein.

Seventy grams of protein represent 287 calories, so that if a person who requires 3,000 calories takes 70 grams of protein, the proportion of calories taken in the form of protein is 9·6 per cent. of the total nutriment. This proportion of protein to total foodstuff is possible, without difficulty, on a vegetarian diet, but we must not reckon that all vegetable foods contain an average of 9 per cent. of protein, because, for instance, potatoes contain only 7·1 per cent., rice 7·3 per cent., rye bread 8·7. per cent., and there are numerous vegetable foodstuffs —oil, sugar, apples, beer, cocoa—which contain very much less or none at all. With animal foodstuffs we can reckon on the considerably higher average of from 15 per cent. to 16 per cent. of protein, in spite of the large proportion of fats, which contain practically none; for instance, the percentage for bacon is 5·3 per cent., for fat pork 15 per cent., for liver sausage 15·4 per cent., for milk 20 per cent., for eggs 31·5 per cent., so that in a mixed diet there is an increased percentage of calories taken as protein.

PROTEIN IN SOME IMPORTANT FOODSTUFFS.

Vegetable Foodstuffs.	Utilisable Nutrient.		Animal Foodstuffs	Utilisable Nutrient.	
	Protein calories per cent. of total calories.	Protein in 3,000 calories, grams.		Protein calories per cent. of total calories.	Protein in 3,000 calories, grams.
Sugar	—	—	Lard	0·1	1
Honey	1·0	8	Butter	0·4	3
Apples	2·3	17	Bacon	5·3	39
Beer	3·6	27	Pork, fat	15·0	109
Cocoa	4·5	33	Liver sausage	15·4	113
Potatoes	7·1	52	Milk	20·0	146
Rice	7·3	53	Beef, fat	24·6	180
Rye bread (fine)	8·7	64	Rich cheese	28·1	206
Wheat bread (fine).	8·8	64	Eggs	31·5	230
Carrots	9·5	69	Salt herrings	33·5	245
Vermicelli Macaroni	10·7	78	Skimmed milk cheese	53·5	392
Turnip-rooted cabbage	12·6	92	Pork, lean	59·1	432
Red cabbage	20·3	149	Beef, lean	76·8	562
Peas	26·5	194	Codfish	96·8	708

Though we are fully aware of the seriousness of any radical change in our diet, we affirm that a grown man ought to take an average of 11 per cent. of his calories in the form of protein; this would mean that fully a third of his food should be animal foodstuffs. The healthy man would thus take 330 of his 3,000 calories in the form of protein, and his daily requirement would rise from 70 grams to 80 grams of protein.

Out of respect for our customary methods of nourishment, this figure considerably exceeds what is physiologically necessary; but it is desirable that it should do so, because it would be impossible to secure that every member of a whole nation should receive an amount of protein exactly corresponding to the average. The nation's diet is made up of the very different diets of separate classes of the population, town and country diets, diets poor in meat or rich in meat, poor in milk or rich in milk, of the middle class, and of the well-to-do. If it were physiologically possible, many people could appease their hunger with any foodstuff they fancied, while others had not enough food to keep them in full health and strength. It would therefore be dangerous to measure the average protein requirements of a man as if the protein could be evenly distributed over the whole nation, for to do so would be to crush the poorest below the permissible limit.

The protein requirement of a woman is put as a rule at from 10 per cent. to 20 per cent. lower than that of a man in view of her smaller weight and lower calorie requirement. We shall choose a middle course here and put the difference at 15 per cent. The protein requirement of a woman is therefore 68 grams.

We must now give special attention to the protein requirements of the child. The amount of protein required for growth is, as a rule, considerably overestimated. The exact metabolic researches of Rubner and Heubner show that for a baby a daily supply of from 1 to 3 grams of protein per kilogram of body weight is enough to enable it to grow sufficient body substance. König demands only 2·6 grams, but this is for breast-fed infants. For babies fed exclusively with cow's milk (undiluted and without sugar) this figure rises to 4·6 grams. The greater consumption of protein is in this case connected with the calorie requirement; cow's milk is so rich in protein that the milk supplied to meet the calorie requirement contains more protein than the child needs. The superfluous protein is then used for the production of energy in exactly the same way as the protein which exceeds the wear and tear quota is used in the case of adults. The same holds good, of course, for older children, and this is why such varying figures have been found for the protein consumption of growing persons.

If, on the authority of König and others, we now put the daily protein requirement per kilogram of body weight at 3 to 3½ grams up to 6 years of age, 2 to 2½ grams from 7 to 12 years, and 1½ to 1¾ grams from 13 to 18 years of age, we get an average daily requirement of (digestible) protein of roughly 40 grams for the first to sixth year, 50 grams for seventh to twelfth year, and 65 grams for thirteenth to eighteenth year. According to Voit, a requirement of about 1½ grams per kilogram, of body weight should be added for adults, however, as shown above, 80 grams for a grown man, and 68 grams for a grown woman, *i.e.*, about 1¼ grams per kilogram of body weight, are amply sufficient, even having regard to the customary mixed diet.

On the basis of our calculations for the individual, we can now reckon the protein requirements of the whole population. To do this we must again have recourse to the age and sex distribution of the German nation on December 1, 1911, and we then find a total daily need of 4,203 tons.

DAILY PROTEIN REQUIREMENTS OF THE POPULATION ON JANUARY 1, 1911.

Age.	Sex.	Population.	Daily Protein Requirement.	
			Per head. grams.[1]	Total. tons.[2]
0–6	male, female	9,407,972	40	376·3
6–12	,, ,,	8,714,176	50	435·7
12–18	,, ,,	7,969,470	65	518·0
18 and over	male	18,972,161	80	1,517·8
	female	19,928,459	68	1,355·1
Total	—	64,992,238	—	4202·9

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[1] 1 gram = 15½ grains approximately.

[2] The ton quoted in this work is the metric ton of 1,000 kilograms, which is equal to 2,204·6 lb. avoirdupois, while the English ton is 2,240 lb.

If we use Voit's scale, we must raise the protein requirements of adults by 20 per cent. The total daily requirement would then be 4,777 tons.

We obtain a somewhat lower figure, however, if we rely on the researches of Rubner and regard the proportion of calories which must be supplied in the form of protein as the same on the whole for all ages. Multiplying the protein requirement of the healthy adult man, *i.e.*, 80 grams, by the requirement units of the population of Germany on January 1, 1911, we find the daily requirement of the total population to be

80 grams × 49,543,889 = 3,964 tons.

We have already shown for what reasons Voit's scale seems to us to exceed the actual requirements. In order to avoid any underestimate, however, we will not make use of the lower figure, which is founded on an equal protein requirement for all ages, although it probably comes nearest to the truth. The daily requirement of 4,203 tons for the total population on January 1, 1911, which we calculated, stands between the two. Allowing for the increase of the population to 68 millions at the outbreak of war, *i.e.*, by 4·6 per cent., this daily requirement rises to 4,396 tons. The yearly requirements of the German nation thus amount to

4,396 tons of protein × 365 = 1,605,000 tons of protein.

CHAPTER IV

THE FOOD CONSUMPTION OF THE GERMAN NATION

How great is our need of food supplies has already been shown. Now the question arises, How much did we actually consume before the war? In order to find out, we must examine the foodstuffs produced in Germany and eaten by man, and also the nett imports —that is, the excess of imports over exports of such foodstuffs. In order further to ascertain what part of our consumption we owe directly or indirectly to the foreigner, we must add to the nett imports of completed foodstuffs the nett imports of such materials as have assisted in the home production of foodstuffs. For example, we find our total meat consumption by adding the meat obtained by home slaughtering to the excess of meat imports over meat exports, and the portion of our meat consumption which we owe to the foreigner by adding together the nett imports of (1) meat, (2) live cattle, and (3) fodder which helped to rear the cattle killed here (converted into meat). Consumption, imports, and exports were calculated as far as practicable for the years 1912 and 1913, and an average drawn from them. In particular we endeavoured to include all human foodstuffs as widely as possible; but of course these foodstuffs were only taken into account in so far as they served directly or indirectly as human food. For instance, under grain we included barley and maize where as pig's food they produced pork, but not where they served as food for horses. And in animal fats we included lard, which is, of course, a food, and oleo-margarine, which is used in the manufacture of margarine; but not denaturalised beef tallow, which is used exclusively in industry.

1. *Grain, Rice, Pulse, Potatoes*

In order to find the human consumption of vegetable food (grain, rice, pulse, potatoes), we must subtract from the home harvest the amounts used for sowing, for feeding animals, and for industrial purposes, and add the excess of imports over exports so far as it is not used for feeding animals and for industrial purposes.

Home-grown barley used in brewing is thus deducted here, and will be considered later as raw material for beer. The same holds good for the nett import of barley malt, while the nett import of fodder, barley and maize used for fattening pigs is considered in the paragraph relating to meat consumption.

Home Produce.—The harvest yields of rye, wheat, bearded wheat, barley, oats, and potatoes were in general taken from Imperial statistics. The amounts used for sowing were reckoned in accordance with the practice of the Imperial Statistics Office, and for one hectare[1] of arable land the following were allowed: rye or winter wheat, 170 kilograms; summer wheat, 184 kilograms; winter bearded wheat, 193 kilograms; summer bearded wheat, 225 kilograms; barley, 150 kilograms; oats, 160 kilograms; potatoes, 2,000 kilograms. From what remained after this deduction for sowing we set aside as deduction for animal fodder and industrial purposes:

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[1] 1 hectare = approximately 2½ acres (2·471 acres).

wheat and bearded wheat, 10 per cent.; rye, 25 per cent.; potatoes, 70 per cent.; barley, 85 per cent.; oats, 95 per cent. Of the other cereals (buckwheat, millet, spelt, maize) and pulse, for which there are no official figures in regard to crops, we reckoned 150,000 and 400,000 tons respectively as available for human food. The total weight of grain, potatoes, and pulse used for human food is thus found to be 27,317,791 tons.

HOME PRODUCTION OF VEGETABLE FOODS. AVERAGE FOR 1912, 1913.

Vegetable.	Harvest yield. tons.	Deducted for		Available for human consumption. tons.
		Sowing. tons.	Animal fodder and industrial purposes. tons.	
Rye	11,910,342	1,078,004	2,708,085	8,124,253
Wheat	4,508,290	334,446	417,384	3,756,460
Bearded wheat	423,976	53,840	37,014	333,122
Barley	3,647,377	247,679	2,889,743	509,955
Oats	9,117,074	706,049	7,990,474	420,551
Buckwheat, millet, etc.... ...	—	—	—	150,000
Peas, lentils, beans, etc.... ...	—	—	—	400,000
Potatoes	52,165,306	6,753,807	31,788,049	13,623,450
Total ...	—	—	—	27,317,791

Nett Imports.—The import and export of vegetables can be seen at once from the statistics of foreign trade. On an average for the years 1912 and 1913 the imports were 9,017,919 tons, exports 2,747,559 tons, and nett imports therefore 6,270,360 tons.

IMPORT AND EXPORT OF VEGETABLE FOODS. AVERAGE FOR 1912, 1913.

GOODS.	Imports tons.	Exports. tons.	Nett imports. tons.
Rye	334,133	865,890	−531,757
Wheat	2,421,690	430,469	1,991,221
Bearded wheat	9	2,146	−2,137
Malt barley	181,818	—	181,818
Other barleys	2,921,996	3,630	2,918,366

GOODS.	Imports. tons.	Exports. tons.	Nett imports tons.
Oats	585,479	523,430	62,049
Buckwheat	28,315	424	27,891
Millet	20,567	46	20,521
Maize; Dari	1,030,518	45	1,030,473
Other cereals	—	1	−1
Malt	49,967	18,909	31,058
Rice, unpolished	131,947	18	131,929
Beans	33,416	1,985	31,431
Peas	259,293	8,407	250,886
Lentils	30,726	2,249	28,477
Beans for fodder (horses, etc.)	20,427	526	19,901
Lupins	9,984	603	9,381
Vetches	20,222	1,111	19,111
Potatoes	602,180	228,948	373,232
Rye meal	1,034	196,976	−195,942
Wheat meal	16,870	182,893	−166,023
Oatmeal, barleymeal, pease, etc.	356	4,728	−4,372
Rice, polished	316,528	178,324	138,204
Pearlbarley, semolina, groats, ground rice	330	42,708	−42,378
Crushed oats, seconds flour, etc.	114	53,093	−52,979
Total	9,017,919	2,747,559	6,270,360

From these, however, the amounts used for animal fodder and for industrial purposes have to be deducted. Malt barley and malt, as already mentioned, do not come into the question here, being raw materials for beer brewing. This also applies to the nett import of oats, maize, fodder beans, lupins, and vetch, which are reckoned entirely as fodder or industrial materials. Ninety per cent. of other barleys is deducted as fodder, &c., and 20 per cent. of unpolished rice is deducted for industrial purposes; there then remains a nett import for human consumption of 2,263,654 tons.

Consumption.—Grain intended for human food has first to be prepared in order to be edible. This is done mainly by grinding. We will estimate here that the amount of meal obtained by grinding rye is 70 per cent., wheat and bearded wheat 77 per cent., barley 60 per cent., oats 55 per cent. With buckwheat and millet we allow 15 per cent. waste, and with unpolished rice 30 per cent. Thus the total consumption of vegetable food is found to be 23,524,300 tons (home produce) + 1,810,000 tons (nett imports) = 25,334,300 tons. Reckoned as actual nutriment, this means 1,123,700 tons of protein, 121,000 tons of fat, 10,005,000 tons of carbohydrates, and 46,653 milliard[1] calories.

Consumption of Vegetable Foods. Average for 1912, 1913.

	Edible.			Actual Nutriment.							
	Home Production.	Nett Imports.	Consumption.	Protein.	Fat.	Carbohydrates.	Calories per kilogram.	Protein.	Fat.	Carbohydrates.	Milliard Calories.
	In 1,000 tons.			percentages.				In 1,000 tons.			
Rye meal	5,687·0	−568·2	5,118·8	6·7	0·9	69·8	3,220	343·0	46·1	3,572·9	16,483
Wheat meal	2,892·5	1,367·2	4,259·7	8·8	0·9	68·7	3,260	374·9	38·3	2,926·4	13,887
Bearded wheat (meal, etc.) ...	256·5	−1·6	254·9	8·8	0·9	68·7	3,260	22·4	2·3	175·1	831
Barley (meal, pearl barley, groats, etc.)	306·0	132·7	438·7	8·6	1·5	64·3	3,130	37·7	6·6	282·1	1,373
Oats (meal, crushed, etc.)	231·3	−57·4	173·9	10·5	4·1	63·1	3,400	18·3	7·1	109·7	591
Buckwheat, millet (meal, groats, etc.)	127·5	41·2	168·7	7·2	1·0	69·5	3,240	12·1	1·7	117·2	547
Rice	—	212·1	212·1	5·9	0·3	74·7	3,330	12·5	0·6	158·4	706
Peas, lentils, beans	400·0	310·8	710·8	17·0	0·6	45·9	2,640	120·8	4·3	326·3	1,877
Potatoes	13,623·5	373·2	13,996·7	1·3	0·1	16·7	740	182·0	14·0	2,337·4	10,358
Total	23,524·3	1,810·0	25,334·3	—	—	—	—	1,123·7	121·0	10,005·5	46,653

Contribution from Abroad.—We received from abroad chiefly wheat, rice, and pulse, and in comparatively smaller quantities barley, potatoes, buckwheat, and millet, while we exported principally rye, but also oats. The receipts from abroad, as already shown, amount to about

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[1] A milliard is a thousand million (1,000,000,000). A billion is a million million (1,000,000,000,000).

1,810,000 tons. In actual nutriment this means 160,700 tons of protein, 10,100 tons of fat, 982,700 tons of carbohydrates, and 4,778 milliard calories. Of our total consumption of vegetable food we therefore owe 14 per cent. of protein and 10 per cent. of total calories to the receipts from abroad.

2. *Green Vegetables, Fruit, Sugar, Honey, Vegetable Fats*

(a) *Green Vegetables.*

Home Production of Green Vegetables.—In spite of the importance of growing green vegetables both to the national economy and to human nourishment, it is impossible unfortunately at the present time to make any valuation with even the most modest claim to reliability of the total home production. On the basis of official statements in regard to arable land (though they are quite insufficient) and of the very varied statements in regard to crops which appear in print, we will estimate the yield at 6,000,000 tons.

Nett Imports.—In regard to foreign trade in green vegetables, exact and reliable information is forthcoming. The chief imports are cucumbers, cauliflowers, and onions, and the chief export is cabbage. On the whole, the trade in vegetables concerns quantities so small in comparison with home production that, considering our meagre knowledge of that home production, it is not worth while setting out the imports and exports in full. On an average for the years 1912 and 1913 the imports were 326,739 tons, the exports 54,682 tons, and the nett imports therefore 272,057 tons.

Consumption.—The consumption of green vegetables is thus seen to be

6,000,000 tons + 272,057 tons = 6,272,057 tons.

Reckoned as utilisable nutriment, this means 75,300 tons of protein, 12,500 tons of fat, 376,300 tons of carbohydrates, and 1,944 milliard calories.

Consumption of Green Vegetables. Average for 1912, 1913.

Home production.	Nett imports.	Consumption.	Actual Nutriment.							
			Protein.	Fat.	Carbohydrate.	Calories per kg.	Protein.	Fat.	Carbohydrates	Milliard Calories
in 1,000 tons.			percentages.				in 1,000 tons.			
6,000·0	272·1	6,272·1	1·2	0·2	6·0	310	75·3	12·5	376·3	1,944

Receipts from Abroad.—The receipts from abroad, as has been shown, amounted to 272,057 tons. Reckoned as actual nutriment, this means 3,300 tons of protein, 500 tons of fat, 16,300 tons of carbohydrates, and 84 milliard calories. About 4 per cent., therefore, of our total consumption of green vegetables comes from abroad.

(b) *Fruit*

Home Production of Fruit.—In the year 1900, 52,332,087 apple trees, 25,116,266 pear trees, 69,435,817 plum trees, and 21,547,683 cherry trees were counted in the German Empire—altogether 168,431,853 fruit trees. The results of the second census of the Empire in the year 1913 are not yet known. In Prussia, on December 1, 1913, after a preliminary estimate, the amount was 106,970,868 as against 90,388,434 in the year 1900, thus showing an increase of 18·35 per cent. If we estimate the increase for the Empire up to January 1, 1913, at

17 per cent., and assume that this increase was equally distributed among all kinds of fruit trees, we obtain this result: 61,229,000 apple trees, 29,386,000 pear trees, 81,240,000 plum trees, and 25,211,000 cherry trees. There are no statistics of produce for the Empire, but only for the period 1878 to 1911 for Würtemberg. If we estimate the produce of the Empire on an average for the years 1912 and 1913 to have been 10 per cent. more than it was in Würtemberg on an average of the years 1878 to 1911 for bearing trees, we arrive at a total yield of 2,042,900 tons. No comprehensive details are forthcoming in regard to the number and yield of other kinds of fruit trees or bushes. We will estimate their yield at 500,000 tons. The total home production of fruit would therefore be 2,542,900 tons.

HOME PRODUCTION OF FRUIT. AVERAGE FOR 1912, 1913.

Fruit.	Number of fruit trees.	Yield of one tree, kilograms.	Total yield 1,000 tons.
Apples	61,229,000	18	1,102·1
Pears	29,386,000	16	470·2
Plums	81,240,000	3	243·7
Cherries...	25,211,000	9	226·9
Other fruits	—	—	500·0
Total	—	—	2,542·9

Nett Imports.—Certain goods which are included in commercial statistics must be excluded here, since they are principally used in wine making or as fodder (fresh vintage grapes, pressed and fermented grapes, wine pulp, useful waste apples and pears, carob-beans). After deduction of these goods, the imports on an average for the years 1912 and 1913 are found to be 847,924 tons, the exports 23,232 tons, and the nett imports 824,692 tons.

IMPORT AND EXPORT OF FRUIT. AVERAGE FOR 1912 AND 1913.

Fruit.	Imports. tons.	Exports. tons.	Nett imports. tons.
Apples	318,690	2,195	316,495
Pears, quinces	48,528	2,431	46,097
Plums	27,920	9,947	17,973
Cherries...	9,015	859	8,156
Other fresh fruits	92,110	3,486	88,624
Dried, pressed, etc., fruits	53,227	2,266	50,961
Southern fruits and fruit rinds ...	296,426	1,958	294,468
Fruit and plant juices	2,008	90	1,918
Total	847,924	23,232	824,692

Consumption.—The consumption is thus seen to be 2,542,900 tons + 824,692 tons = 3,367,592 tons. In actual nutriment this means 23,200 tons of protein, 36,000 tons of fat, 411,500 tons of carbohydrates and 2,117 milliard calories.

CONSUMPTION OF FRUIT. AVERAGE FOR 1912, 1913.

Fruits.	Home Production.	Nett Imports.	Consumption.	Actual Nutriment.							
				Protein.	Fat.	Carbo-hydrates.	Calories per 1 kg.	Protein.	Fat.	Carbo-hydrates.	Milliard calories.
	in 1,000 tons.			percentages.				in 1,000 tons.			
Apples	1102·1	316·5	1418·6	0·3	—	11·9	500	4·3	—	168·8	709
Pears	470·2	46·1	516·3	0·3	—	11·3	480	1·5	—	58·3	248
Plums...	243·7	18·0	261·7	0·7	—	12·0	520	1·8	—	31·4	136
Cherries	226·9	8·1	235·0	0·9	—	11·2	490	2·1	—	26·3	115
Other fresh fruits ...	500·0	88·6	588·6	1·7	5·5	8·3	920	10·0	32·4	48·9	542
Dried, pressed, etc., fruits	*	51·0	51·0	1·5	—	49·0	2,080	0·8	—	25·0	106
Tropical fruits and juices	—	296·4	296·4	0·9	1·2	17·8	880	2·7	3·6	52·8	261
Total	2542·9	824·7	3367·6	—	—	—	—	23·2	36·0	411·5	2117

* Included under Fresh Fruits.

Contribution from Abroad.—The receipts from abroad, which comprised chiefly apples and tropical fruits, amounted, as has been shown, to 824,692 tons. Reckoned as actual nutriment, this means 6,200 tons of protein, 8,500 tons of fat, 131,200 tons of carbohydrates, and 642 milliard calories. Of our total consumption, therefore, 27 per cent. of protein and 30 per cent. of calories are due to imports from abroad.

(c) *Sugar*

The output, foreign trade, and consumption of sugar for the trade year September 1 to August 31 are published annually by the Imperial Statistics Office. If, as is done in official statistics, we reckon the proportion of raw sugar to refined sugar as 10 to 9, the figures on an average for the trade years 1911–12 and 1912–13 are: output (1911–12 unusually poor), 1,891,823 tons; imports, 2,145 tons; exports, 601,739 tons. For home consumption there therefore remained 1,292,229 tons. As a matter of fact, 1,199,344 tons were placed on the market, and this represents the consumption, while there was a nett export of 599,594 tons. Reckoned as actual nutriment, this consumption means 1,174,100 tons of carbohydrates and 4,689 milliard calories.

CONSUMPTION OF SUGAR. AVERAGE FOR 1912, 1913.

Home production.	Nett Export.	For disposal.	Consumption.	Actual nutriment.			
				Carbohydrates per cent.	Calories. per kg.	Carbohydrates 1000 tons.	milliard calories.
In 1,000 tons.							
1891·8	599·6	1292·2	1199·3	97·9	3,910	1174·1	4,689

The nett exports, on the other hand, represent 587,000 tons of carbohydrates and 2,344 milliard calories—that is, exactly half the consumption.

(d) *Honey*

In the cattle census of December 2, 1912, the yield of honey in the year 1912 was also calculated. With the exception of the stock left to the bees for hibernation, it amounted to 15,235 tons. On an average for the years 1912 and 1913, the imports were 4,477 tons, and the exports 2,482 tons. (The small amounts also referred to in the trade statistics as "Honey in hives with live bees" need not be taken into account here.) The nett imports were therefore 1,995 tons, and the total consumption 15,235 tons + 1,995 tons = 17,230 tons. Reckoned as actual nutriment, this represents 140 tons of protein, 13,400 tons of carbohydrates, and 56 milliard calories. Of this 6·5 milliard calories, or 12 per cent., was imported from abroad.

Consumption of Honey. Average for 1912, 1913.

			Actual Nutriment.					
Home Production (1912)	Nett Imports.	Consumption.	Protein.	Carbohydrates	calories. 1 kg.	Protein.	Carbohydrates.	milliard calories.
In 1,000 tons.			percentages.			In 1,000 tons.		
15·2	2·0	17·2	0·8	78·1	3,240	0·1	13·4	56

(e) *Vegetable Fats*

In order to ascertain the consumption of vegetable fats for food, we must subtract from the fats obtained in the country from home-grown and imported plants the amounts used for other purposes and also the excess of exports over imports of fats used for human food.

Home Production.—We have only inadequate information in regard to the production of oils and fats from home-grown plants. On the basis of the very incomplete statements in regard to the land cultivated and the crops, we may put the yield at 40,000 tons. The oils and fats obtained from imported plants are far more extensive. Apart from mustard seed, which is principally used for sowing purposes, the total import of oil plants and oil seeds on an average for the years 1912 and 1913 was 1,587,891 tons. It consisted principally of linseed, palm kernels, cotton seed, and copra. On the other hand, the exports amounted only to 15,966 tons, so that the nett imports were 1,571,925 tons. To ascertain the amount of oils obtained from this, we have subtracted from the fat contained in the oil plants and oil seeds the fat contained in the oilcakes and meal for fodder manufactured therefrom, and also 2 per cent. for waste. In doing so we have assumed that the whole of the protein contained in the plants and seeds is transferred to the cakes and meal. In this way, we found the oil produce from the nett import of oil plants and oil seeds to be 572,190 tons.

The total home production of oils was therefore 40,000 tons + 572,190 tons = 612,190 tons.

IMPORTS AND EXPORTS OF OIL NUTS AND OIL SEEDS.
AVERAGE FOR 1912, 1913.

Seeds, etc.	Imports.	Exports.	Nett Imports.	Raw Fats.		Oil.	Digestible crude protein.	
				Total.	oil obtained.			
	tons.	tons.	tons.	p. c.	p. c.	tons.	p. c.	tons.
Colza, rapeseed	139,555	6,039	133,516	45·0	39·7	53,006	15·9	21,229
Dodder, Chinese radish mustard seed ...	2,590	21	2,569	29·9	22·3	573	19·1	491
Poppy, sunflower	18,495	135	18,495	37·7	31·5	5,826	13·9	2,571
Beechnuts, etc.	383		383	27·4	22·5	86	10·7	41
Peanuts	83,978		83,978	49·2	43·2	36,278	26·7	22,422
Sesame	107,660		107,525	47·2	39·8	42,795	8·4	19,785

Seeds, etc.	Imports.	Exports.	Nett Imports.	Raw Fats.		Oil.	Digestible crude protein.	
				Total.	Oil obtained.			
	tons.	tons.	tons.	p. c.	p. c.	tons.	p. c.	tons
Linseed, Linseed meal ...	445,260	4,816	440,444	36·5	31·5	138,740	19·4	85,446
Hempseed ...	8,586	2,830	5,756	32·6	28·4	1,635	13·7	789
Copra	189,928	819	189,109	67·0	62·1	117,437	9·1	17,209
Cottonseed ...	216,947	1,306	216,947	25·8	20·7	44,908	14·5	31,457
Soya beans, etc.	125,488		125,488	17·5	14·5	18,196	29·5	37,019
Palm kernels...	248,665		247,715	48·8	45·5	112,710	8·0	19,817
Other oil nuts and seeds ...	356		—	—	—	—	—	—
Total ...	1,587,891	15,966	1,571,925	—	—	572,190	—	258,276

Nett Exports.—According to statistics of foreign trade, on an average for the years 1912 and 1913 the imports of oils and vegetable fats were 88,439 tons, the exports 124,277 tons, and the nett exports were therefore 35,838 tons.

IMPORT AND EXPORT OF OILS AND VEGETABLE FATS.
AVERAGE FOR 1912, 1913.

	Imports. tons.	Exports. tons.	Nett Imports. tons.
Fat oils	59,702	19,448	40,254
Vegetable fats	16,652	55,194	−38,542
Oleic acid, oil dregs	11,802	1,567	10,235
Vegetable tallow for food	65	47,732	−47,667
Margarine, margarine cheese and artificial fats	218	336	− 118
Total	88,439	124,277	−35,838

Consumption.—The total consumption of vegetable fats is thus found to be 612,190 tons − 35,838 tons = 576,352 tons. A large proportion is used for industrial purposes as well as for human food. Unfortunately, there are no reliable data on which to base an estimate of this proportion. If we assume that two-thirds are used in industry (soaps, candles, dyes, linoleum, etc.). and one-third for human food (including the preparation of margarine), the consumption of vegetable fats for human food would amount to 192,117 tons. Reckoned as actual nutriment, this represents 184,400 tons of fat and 1,715 milliard calories.

Contribution from Abroad.—To ascertain the amount of vegetable fats which we owe directly or indirectly to the foreigner, we must subtract from the amount obtained here, from imported plants, the nett export of vegetable fats. First, however, we must set aside the fats intended for industrial purposes. Here again we must have recourse to estimates. We will assume that the following serve as human food: two-thirds of the fats obtained from home-grown plants, *i.e.*, 26,667 tons; one-half of the exported fats, *i.e.*, 62,139 tons; one-quarter of the imported fats *i.e.*, 22,110 tons. Thus of the fats obtained in the country from foreign plants, 192,117 tons - 26,667 tons + 62,139 tons - 22,100 tons = 205,489 tons are fats used for human food; while the contribution from abroad would amount to 205,489 tons + 22,100 tons - 62,139 tons = 165,450 tons. Reckoned as actual nutriment, this represents 158,900 tons of fat and 1478 milliard calories. Eighty-six per cent. of the total consumption thus comes from abroad.

CONSUMPTION OF VEGETABLE FATS. AVERAGE FOR 1912, 1913.

Home Production.	Nett Import.			Consumption.	Actual Nutriment.			
	In the form of		total.		Fat.	Calories	Fat	Milliard calories.
	finished fats.	oil nuts etc.						
In 1,000 tons.					p. c.	per kg.	1,000 tons.	
232·1	– 40·0	205·1	165·5	192·1	96	8,930	184·4	1,715

3. *Colonial Goods and Alcoholic Liquors.*

(a) *Colonial Goods*

Without exception, these are foreign products. We have therefore only to consider foreign trade. We have already reviewed cane sugar in conjunction with beet sugar. Coffee and tea, in the form in which they are ordinarily used, are of so little value as nourishment that we need not include them, and the same holds good for spices. We can therefore confine ourselves to cocoa (and chocolate). On an average for the years 1912 and 1913 the imports were 56,721 tons, the exports 5,147 tons, and the nett imports 51,574 tons. Reckoned as actual nutriment, this consumption represents 3,000 tons of protein, 23,700 tons of fat, 10,300 tons of carbohydrates and 273 milliard calories.

CONSUMPTION OF COCOA. AVERAGE FOR 1912, 1913.

Consumption.	Actual Nutriment.							
	Protein.	Fat.	Carbohydrates	Calories. per kg.	Protein.	Fat.	Carbohydrates.	Milliard calories.
1,000 tons.	Percentages.				In 1,000 tons.			
51·6	5·8	46	20	5,300	3·0	23·7	10·3	273

(c) *Alcoholic Liquors*

The output, foreign trade, and presumed consumption of beer are published annually by the Imperial Statistics Office. The latest information refers to the year April 1, 1912, to March 31, 1913. According to this, the output was 67,872,000 hectolitres[1]; imports 403,000 hectolitres; exports 789,000 hectolitres; presumed consumption 67,486,000 hectolitres. Reckoned as actual nutriment, this consumption represents 27,000 tons of protein, 337,400 tons of carbohydrates, 222,700 tons of alcohol, and 3,037 milliard calories.

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[1] 1 hectolitre = $21\frac{7}{8}$ gallons approximately.

Though we have, on the one hand, a nett export of beer, it must be remembered, on the other, that part of the beer produced here is prepared from imported brewing barley and malt. As has already been shown, on an average for the years 1912 and 1913 the nett imports of brewing barley were 181,818 tons, and of malt 31,058 tons. Assuming that the preparation of 1 hectolitre of beer requires 18·5 kilograms of malt and the preparation of 1 kilogram of malt 1·35 kilograms of barley, the 181,818 tons of brewing barley would represent a beer production of 7,280,000 hectolitres, and the 31,058 tons of malt a beer production of 1,679,000 hectolitres. The nett import of brewing barley and malt is thus responsible for a production of 8,959,000 hectolitres. The total receipts from abroad would then amount to 8,959,000 hectolitres − 386,000 hectolitres = 8,573,000 hectolitres. In actual nutriment, this represents 3,400 tons of protein, 42,900 tons of carbohydrates, 28,300 tons of alcohol and 386 milliard calories. Thirteen per cent. of the total consumption therefore comes from abroad.

Consumption of Beer. Average for 1912, 1913.

Home Production.	Nett Import.			Consumption.	Actual Nutriment.							
	In form of		Total.		Protein.	Carbohyd.	Alcohol.	Calories per kg.	Protein.	Carbohyd.	Alcohol.	Milliard calories.
	Beer	Barley and malt.										
in 1,000 hectolitres.					gr. in 1 litre.				In 1,000 tons.			
67,872	−386	8,959	8,573	67,486	4	50	33	450	27·0	337·4	222·7	3037

The approximate consumption of home and foreign brandy and the amount of manufactured alcohol are published annually by the Imperial Statistics Office for the trade year October 1 to September 30. Calculated at 100 per cent. alcohol, on an average for the trade years 1911–12 and 1912–13 the figures are as follows: home production, 1,909,380 hectolitres; imports, 12,512 hectolitres; exports, 19,526 hectolitres; consumption, 1,902,366 hectolitres. There is thus a nett export of 7,014 hectolitres. Reckoned as actual nutriment, this consumption represents 142,700 tons of alcohol, and 999 milliard calories.

Consumption of Brandy (calculated at 100 per cent. Alcohol).
Average for 1912, 1913.

Home Production.	Nett Export.	Consumption.	Actual Nutriment.			
In 1,000 hectolitres.			Alcohol gr. per litre.	Calories per litre.	Alcohol 1,000 tons.	Milliard calories.
1909	7	1902	750	5,250	142·7	999

Wine is of far less importance as human food. The yield of wine-must on an average for the years 1912 and 1913 was 1,512,170 hectolitres. We will here regard 1 hectolitre of must as equal to 1 hectolitre of wine, and we believe we are justified in so doing, since we have already taken full account of the sugar added thereto. The imports of wine-must and grapes amounted to 176,058 tons, the exports to 22,640 tons, and the nett imports to 153,418 tons. Putting 1 litre = 1 kilogram, the total consumption appears as 1,512,170 hectolitres + 1,534,180 hectolitres = 3,046,350 hectolitres. Reckoned as actual nutriment, this represents 6,700 tons of carbohydrates, 22,500 tons of alcohol, and 183 milliard calories.

Thus 3,400 tons of carbohydrates, 11,400 tons of alcohol, and 92 milliard calories—that is, 50 per cent. of the total consumption—comes from abroad.

Consumption of Wine. Average for 1912, 1913.

Home Production.	Nett Imports.	Consumption.	Actual Nutriment.					
			Carbohyd.	Alcohol.	Calories per litre.	Carbohyd.	Alcohol.	Milliard calories.
In 1,000 hectolitres.			Gr. per litre.			1,000 tons.		
1,512	1,534	3,046	22	74	600	6·7	22·5	183

Thus in actual nutriment the total consumption of alcoholic liquors represents 27,000 tons of protein, 344,100 tons of carbohydrates, 387,900 tons of alcohol, and 4,219 milliard calories. Of this we owe indirectly or directly to the foreigner 3,400 tons of protein, 46,300 tons of carbohydrates, 39,200 tons of alcohol, and 474 milliard calories. Thus 13 per cent. of protein and 11 per cent. of the total calories came from abroad.

4. *Meat and Fish*

(a) *Meat*

In order to ascertain the consumption of meat before the war we must add to the home-killed meat the excess of meat imports over meat exports.

Home Slaughterings.—We have ample information in regard to the number of home-slaughtered cattle, swine, sheep, and goats, for in addition to the annual statistics of inspected slaughterings for the year December 1, 1911, to November 30, 1912, we possess an estimate of private slaughterings. For horses and dogs we know only the inspected slaughterings, which as regards horses probably represent the majority, and as regards dogs only a small proportion of the total slaughterings of these animals. However, in view of the relatively small consumption of horse and dog flesh, the omission will not affect the total result. There is no information in regard to the killing of game and tame rabbits. As regards fowls we have assumed that the annual killing was equal to the stock ascertained on December 2, 1912 (73,374,868); as regards geese and ducks, which were imported in large numbers, we have assumed the killing to be double the stock (6,721,802 and 2,605,360 respectively). As regards pigeons and rabbits, of which the stock is only known for a few Federal States, we estimated the annual killings as respectively 30 times the stock in Baden (235,654 pigeons), and 5 times the stocks in Baden (170,945 rabbits), Bavaria (359,252 rabbits) and Alsace-Lorraine (669,140 rabbits) added together. In regard to the amount of game shot there are official statistics for the year April 1, 1885, to March 31, 1886, in Prussia, and for the calendar year 1908 in Bavaria, and in addition there are estimates by Erler of the increase in the amount of game shot in Prussia up to 1909. We have made use of these estimates here and assumed that the amount of game shot in Germany in 1912–13 was one-third more than in Prussia and Bavaria together in 1908–09.

SLAUGHTERINGS. AVERAGE FOR 1912–13.

ANIMALS.	Inspected slaughterings.	Private slaughterings. (1912)	Total slaughterings in 1,000	Average weight per head in kilograms.	Total weight in 1,000 tons.
Bullocks ...	521,240	2,853	524	330	172·9
Bulls	460,612	3,201	464	310	143·8
Cows	1,682,779	33,004	1,716	240	411·8
Heifers (over 3 months) ...	920,212	23,888	944	185	174·6
Calves (up to 3 months) ...	4,227,374	87,601	4,315	40	172·6
Pigs	18,044,692	5,794,165	23,839	85	2026·3
Sheep... ...	2,181,204	509,444	2,691	22	59·2
Goats... ...	472,166	731,855	1,204	16	19·3
Horses ...	171,198	—	171	235	40·2
Dogs	7,744	—	8	10	0·1

ANIMALS.	Inspected slaughterings.	Private slaughterings. (1912)	Total slaughterings in 1,000.	Average weight per head in kilograms.	Total weight in 1,000 tons.
Geese... ...	—	—	13,444	3·5	47·1
Ducks, fowls, pigeons ...	—	—	85,700	1	85·7
Tame rabbits	—	—	6,000	2·5	15·0
Red deer, fallow deer, wild boar, chamois	—	—	65	37	2·4
Roedeer ...	—	—	300	12	3·6
Hares... ...	—	—	5,500	3	16·5
Wild rabbits...	—	—	600	1	0·6
Partridges ...	—	—	5,800	0·4	2·3
Pheasants ...	—	—	800	1	0·8
Other feathered game ...	—	—	2,000	0·3	0·6
Total ...	28,689,221	7,186,011	—	—	3395·4

Having ascertained the number of animals slaughtered annually, the next thing was to estimate the weight of meat obtained. For cattle, pigs, sheep, goats, and horses we selected the particulars calculated by the Imperial Health Office for the year 1912. It has been proved more especially by Ballod and Esslen, as well as by some experts in the meat question, that these amounts are sometimes too high for the real dead weight, but we have thought it best to retain them here in order to include as far as possible the animal fats not fully included in the "dead weight," though they serve as human food. For dogs, poultry, and game we struck averages of the official Bavarian and Saxon statistics and other calculations. The total weight of home-slaughtered animals so calculated is 3,395,400 tons.

Nett Import of Meat and Fat.—A very small part of the home-killed meat is exported. On the other hand, our stock of meat is supplemented by imports from abroad. The amounts of imported and exported meat can easily be found in the trade statistics. On an average for the years 1912 and 1913 the imports were 70,133 tons, the exports 4,509 tons, and the nett imports were 65,624 tons.

More important than the import of meat is the import of animal fats, which is a valuable addition to the stock from home-killed animals. Of course, animal fats are not used exclusively for human food, but also partly for industrial purposes. Therefore we have only considered here lard and fat from pigs and geese, oleomargarine, "first running," tallow from cattle and sheep, and pressed tallow, and only these so far as they were not denaturalised—that is, eleven-twelfths according to the customs statistics for the financial year 1912–13. On an average for the years 1912 and 1913, the imports of animal fats for human food were therefore 161,931 tons, exports 293 tons, nett imports 161,638 tons. The total imports of meat and fat were therefore 232,064 tons, the total exports 4,802 tons, and the total nett imports 227,262 tons.

Imports and Exports of Meat and Animal Fats. Average for 1912, 1913.

Meats and Fats.	Imports.	Exports.	Nett Imports.
	tons.	tons.	tons.
Beef and veal	35,244	113	35,131
Pork	19,509	96	19,413
Ham	1,006	1,314	– 308
Mutton	601	173	433
Goat's flesh	5		
Bacon, spiced bacon	1,799	45	1,754
Goose breast, leg, and liver... ...	225	248	8,805
Poultry	8,828		
Furred game	1,283	254	1,029
Feathered game	423	83	340
Meat-extract, meat-juice	1185	1,450	– 265
Meat sausages	25	622	– 597
Meat not exactly specified	—	111	– 111
Fats for human food	161,931	293	161,638
Total	232,064	4,802	227,262

Consumption.—All the animals killed here and all the imported carcases are not suitable for human food, and furthermore a small part is thrown out at the meat inspection. On the other hand, the edible entrails are not always included in the dead weight, so that a deduction for the unsuitable portions did not seem necessary. The consumption of meat and fat was thus 3,395,400 tons + 227,262 tons = 3,622,662 tons. Reckoned as actual nutriment, this represents 431,900 tons of protein, 1,339,600 tons of fat, 1,400 tons of carbohydrates, and 14,242 milliard calories.

Contribution from Abroad.—The home-killed animals are not all reared here, and the animals reared here are partly fattened with imported fodder. In order to ascertain what proportion of meat consumed here we import directly or indirectly from abroad we must, in addition to the nett import of meat already calculated, consider the nett import of live cattle and of fodder.

The numbers of cattle, pigs, sheep, goats, geese, and horses imported alive and exported can be easily found in the trade statistics. The large number of imported geese is especially noteworthy. In reckoning the dead weight we based our calculations as far as practicable on the details of total slaughterings referred to above. In the trade statistics, as in the customs tariff, the imports and exports of other kinds of animals (ducks, fowls, &c.) are recorded by weight and not by number, so that further calculations were not needed. The total nett import of live animals thus amounted to 108,400 tons.

Import and Export of Live Animals. Average for 1912, 1913.

Animals.	Import number.	Export number.	Nett import number.	Dead weight of each. kgs.	Nett import 1,000 tons.
Bulls	38,760	16	38,744	330	12·8
Bullocks	9,932	181	9,751	310	3·0
Cows	99,201	921	98,280	240	23·6
Steers over 1½ and up to 2½ years ...	39,700	64	39,636	175	14·8
Heifers over 1½ up to 2½ years	18,263	259	18,004		
Calves of 6 weeks to 1½ years	20,421	299	20,122		
Calves under 6 weeks	7,052	93	6,959		
Pigs	140,247	3,462	136,785	90	12·3
Sucking-pigs under 10 kilograms ...	1,122	338	784	8	0·0
Sheep	14,379	12,699	1,680	22	0·0
Goats...	435	697	– 262	16	– 0·0
Lambs	201	1,064	– 863	10	– 0·0
Horses	—	4,824	– 4,824	235	– 1·1
Geese...	8,596,945	18,439	8,578,506	3·5	30·0
	tons.	tons	tons.		
Fowls of all kinds ...	10,572	104	12,982		13·0
Ducks	2,157				
Other poultry ...	357				
Total ...	—	—	—	—	108·4

Barley and maize are the principal imports of fodder required for rearing the animals killed here. The foreign trade in these two cereals has already been noted (see pp. 41–42). The nett imports of fodder barley and maize, on an average for the years 1912 and 1913, amounted to 3,948,839 tons. Of this, 291,837 tons of barley are reckoned as human food. From the remaining 3,657,002 tons, however, the quantities used for horse fodder and for industrial purposes must be deducted. Assuming this proportion to be 20 per cent., 2,925,602 tons would remain, which are mainly used for pig fattening. If we estimate, as is usually done, that five measures of grain are equal to one measure of dead-weight pork, we find that 2,925,602 tons of barley and maize represent 585,120 tons of pork.

By combining the three ways in which we import meat directly or indirectly from abroad (meat, animals, fodder) and including the fats, we arrive at a total amount of 920,800 tons. Reckoned as actual nutriment, this represents 85,000 tons of protein, 462,700 tons of fat, 200 tons of carbohydrates, and 4,655 milliard calories. Thus of our total consumption 20 per cent. of protein and 33 per cent. of total calories come from abroad.

CONSUMPTION OF MEAT AND FATS. AVERAGE FOR 1912, 1913.

Meats and Fats.	Home Production.	Nett Imports.				Consumption.	Actual Nutriment							
		In the form of			Total.		Protein.	Fat.	Carbo-hydrates.	Calories per kg.	Protein.	Fat.	Carbo-hydrates.	Milliard calories.
		Meat, Fat.	Animals.	Fodder.										
	In 1,000 tons.						Percentage.				In 1,000 tons.			
Cattle	1075·7	35·1	54·2	—	89·3	1110·8	1	19	—	2,420	177·7	211·1	—	2,688
Pigs	2026·3	20·9	12·3	585·1	618·3	2047·2	1	45	—	4,600	204·7	921·2	—	9,417
Sheep, goats	78·5	0·4	0·0	—	0·4	78·9	12	30	—	3,280	9·5	23·7	—	259
Horses, dogs	40·3	—	1·1	—	-1·1	40·3	15	8	—	1,360	6·0	3·2	—	55
Geese	47·1	0·2	30·0	—	30·2	47·3	15	43	—	4,610	7·1	20·3	—	218
Other poultry	85·7	8·6	13.0	—	21·6	94·3	19	5	1	1,290	17·9	4·7	0·9	122
Tame rabbits	15·0	—	—	—	—	15·0	21	9	1	1,740	3·2	1·4	0·2	26
Game	26·8	1·4	—	—	1·4	28·2	20	2	1	1,050	5·6	0·6	0·3	30
Meat extracts, juices, sausages	*	-1·0	—	—	-1·0	-1·0	12	20	—	2,350	-0·1	-0·2	—	-2
Lard, etc. ...	*	161·7	—	—	161·7	161·7	0·2	95	—	8,840	0·3	153·6	—	1,429
Total ...	3395·4	227·3	108·4	585·1	920·8	3622·7	—	—	—	—	431·9	1339·6	1·4	14,242

* Included under Meat.

(b) *Fish*

To ascertain the consumption of fish before the war we must add to the produce of the German fisheries the excess of fish imports over fish exports. We will confine ourselves to the real fishes and the products of fish and leave shell-fish and other marine animals out of account. These amount to little more than 1 per cent. of the total, and their inclusion is difficult in view of the fact that in the statistics they are recorded partly by numbers and not by weight.

German Fishery.—The results of German deep-sea fishing and of the fishing in Lake Constance are published annually in the official sea-fishing statistics. In regard to other inland fisheries we must have recourse to estimates. König and Splittgerber estimate the yield for 1906 at 35,200 tons. In view of the fact that the demand has meanwhile greatly increased, we will assume the yield of all the inland fisheries in 1912–13 (including the small yield of Lake Constance) to be 40,000 tons. The total yield of German fisheries, on an average for the years 1912 and 1913, would thus be 215,570 tons.

GERMAN FISH PRODUCTION. AVERAGE FOR 1912, 1913.

Fish Production.	North Sea. tons.	Baltic. tons.	Lakes, rivers and ponds. tons.	Total. tons.
Fresh herrings, sprats ...	2,769	6,316	—	9,085
Other fresh fish	84,460	30,981	40,000	155,441
Salted herrings	45,316	—	—	45,316
Fish liver, fish roes, caviare	5,728	—	—	5,728
Total	138,273	37,297	40,000	215,570

Nett Imports.—Only a small proportion of the produce of German fisheries is exported. On the other hand, there is a large import, particularly of herrings. On an average for the years 1912 and 1913, the whole imports amounted to 385,823 tons, exports 24,446 tons, nett imports 361,377 tons.

Imports and Exports of Fishery Products. Average for 1912, 1913.

Fishery Products.	Imports. tons.	Exports. tons.	Nett Imports. tons.
Fresh fresh-water fish...	9,056	2,892	6,164
Fresh herrings, sprats...	131,502	9,671	121,831
Other fresh salt-water fish	39,526	6,005	33,521
Salted herrings...	188,147	845	187,302
Other prepared fish	17,592	5,033	12,559
Total	385,823	24,446	361,377

Consumption.—The consumption of fish was thus 215,570 tons + 361,377 tons = 576,947 tons. Reckoned as actual nutrients, this represents 52,400 tons of protein, 28,700 tons of fat, 2,000 tons of carbohydrates, and 490 milliard calories.

Consumption of Fishery Products. Average for 1912, 1913.

Fishery Products.	Home Production.	Nett Imports.	Consumption.	Actual Nutriment·							
				Protein.	Fat.	Carbohyd.	Calories per kg.	Protein.	Fat.	Carbohyd.	Milliard calories
	In 1,000 tons.			Per cent.				In 1,000 tons.			
Fresh fresh-water fish ...	40·0	6·2	46·2	10	6	—	970	4·6	2·8	—	45
Fresh herrings, sprats ...	9·1	121·8	130·9	8·1	3·7	—	680	10·6	4·8	—	89
Other fresh salt-water fish	115·5	33·5	149·0	7·4	0·2	—	320	11·0	0·3	—	48
Salted herrings	45·3	187·3	232·6	9·9	8·3	0·8	1,210	23·0	19·3	1·9	281
Other prepared fish... ...	5·7	12·6	18·3	17·5	8·1	0·3	1,470	3·2	1·5	0·1	27
Total ...	215·6	361·4	577·0	—	—	—	—	52·4	28·7	2·0	490

Contribution from Abroad.—The contribution from abroad, as shown, amounted to 361,377 tons. Reckoned as actual nutriment, this represents 33,700 tons of protein, 21,500 tons of fat, 1,500 tons of carbohydrates, and 346 milliard calories. Of our total consumption 64 per cent. of protein and 71 per cent. of total calories come from abroad.

5. *Dairy Produce and Eggs*

(a) *Dairy Produce*

In order to ascertain the consumption of dairy produce before the war we must add the nett imports to the produce of the country available for human consumption.

Home Dairy Produce.—10,205,185 milch cows and 2,608,874 female goats of one year or more were counted in Germany on December 2, 1912. Numerous estimates appear in print in regard to the average annual yield of milch animals, varying in the case of cows mostly between 1,800 and 2,500 litres[1] and in the case of goats between 400 and 550 litres. Comprehensive inquiries for the whole of Germany are not forthcoming. Official estimates were, however, undertaken in Bavaria and Würtemberg in connection with the animal census in 1907. They allow for milch cows in Bavaria 2,340 litres (calculated from the total number of cows), in Würtemberg 1,940 litres, for milch goats in Bavaria 400 litres, in Würtemberg 550 litres. As an average for the Empire we will allow 2,200 litres for cows and 500 litres for goats. The total yield would then amount to 22,451 million litres of cow's milk, and 1304 million litres of goat's milk. The whole of this yield is not available for human consumption; part is used for rearing the animals themselves. We will assume, in accordance with official Bavarian statistics, that the number of young calves, like the number of cattle of less than one year at the beginning of December, is decreased by all the calves of less than three months slaughtered in December and by one-third of those slaughtered in January, and that on an average the young calves consume 538 litres, the calves to be slaughtered 144 litres, and the kids 80 litres. We thus find that 2,850 million litres of cow's milk, *i.e.*, 13 per cent. of the total production, and 56 million litres of goat's milk, *i.e.*, 4 per cent. of the total production, are used directly for rearing stock.

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[1] 1 litre = 1¾ pints approximately.

MILK FOR REARING STOCK.

Calves up to one year on December 2nd, 1912	4,612,631	head
Subtract calves to be killed in December, 1912, and one-third of calves killed in January	433,763	,,
Calves to be reared	4,178,868	,,
Milk consumption of calves (538 litres each) ...	2,248·2	mill. litres
Calves born alive December 1st, 1911, to November 30th, 1912	8,354,629	head
Subtract calves to be reared	4,178,868	,,
Calves to be killed	4,175,761	,,
Milk consumption of calves to be killed (144 litres each)	601·3	mill. litres
Total milk consumption of calves	2,849·5	,,
Goats under one year (kids)	705,705	head
Milk consumption of kids (80 litres each) ...	56·5	mill. litres

Thus of the 22,451 million litres of cow's milk, 19,601 million litres, and of 1,304 million litres of goat's milk, 1,248 million litres would remain for human consumption. We must not leave ewe's milk entirely out of consideration. Assuming, in view of the keeping of milch ewes practised in some districts, that after the weaning of the lambs an average of 30 litres is taken from the ewes for human consumption, 100 million litres of ewe's milk would be available from the 3,320,645 ewes (total on December 2nd, 1912).

Part of the available amount of cow's milk is used unskimmed; in the Press this proportion is put at from 40 per cent. to 43 per cent., that is, 7,800 to 9,000 million litres. Assuming it to be 42 per cent. or 8,232 million litres = 8,487,600 tons, 11,369 million litres remain for making butter and cheese. The proportion which is made into butter is generally estimated at from 50 per cent. to 54 per cent., that is, 10,000 to 12,600 million litres. We will assume it to be 52 per cent. or 10,193 million litres, representing a weight of 10,508,500 tons. Out of 100 kilograms of milk there would then be obtained 3·8 kilograms of butter, 12·2 kilograms of buttermilk, and 82 kilograms of skimmed milk. If this skimmed milk is made into cheese there are further obtained 7 kilograms of brick cheese and 70·5 kilograms of whey. The 10,508,500 tons of milk would thus make 399,300 tons of butter, 1,282,000 tons of buttermilk, and 8,617,000 tons of skimmed milk. The skimmed milk is principally used, like the buttermilk and whey, as cattle food. Assuming that one-fifth of the buttermilk is drunk, one-fifth of the skimmed milk drunk or used in the preparation of margarine, etc., and one-fifth made into cheese (*i.e.*, that three-fifths of the skimmed milk, four-fifths of the buttermilk and the whole of the whey is used for cattle food), we have for human consumption 256,400 tons of buttermilk and 1,723,400 tons of skimmed milk, besides 147,100 tons of skimmed milk cheese and whey cheese. The proportion of unskimmed milk made into cheese is generally reckoned at from 3 per cent. to 10 per cent., *i.e.*, 700 to 2,000 million litres. According to our calculations, the proportion is 6 per cent. or 1,176 million litres = 1,212,600 tons. In making Swiss cheese 100 kilograms of unskimmed milk would produce 8 kilograms of cheese, 1·2 kilograms of buttermilk, 84 kilograms of whey, and 0·8 kilograms of whey butter; and in making Camembert cheese, 13 kilograms of cheese and 74 kilograms of whey. If we take an average cheese production of 10 kilograms the whole 1,212,600 tons of unskimmed milk would produce 121,300 tons of rich cheese.

The goat's milk available for human consumption is used almost exclusively for drinking purposes. In compensation for the fact that we have not considered the whey from cow's milk as human food, we may put the unskimmed goat's milk into our calculations without deduction. A total amount of goat's milk of 1,248 million litres therefore represents a weight of 1,287,900 tons.

The ewe's milk available for human food is, on the contrary, almost entirely made into cheese, and we can reckon 100 kilograms of milk as producing 15 kilograms of cheese. The 100 million litres of ewe's milk = 103,700 tons would therefore produce 15,600 tons of sheep's cheese. The whey, etc., may also be left out of account here as cattle food.

The total home production of dairy produce for human food, so calculated, is 12,438,600 tons.

Nett Imports.—Only a little (part in the form of condensed milk) of the home dairy produce is exported. On the other hand, the stock is slightly increased by imports. On an average for the years 1912 and 1913, the imports were 160,012 tons; exports 23,799 tons; and nett imports therefore 136,213 tons.

IMPORTS AND EXPORTS OF DAIRY PRODUCE. AVERAGE FOR 1912, 1913.

Goods.	Imports. tons.	Exports. tons.	Nett Imports. tons.
Milk, skimmed milk	37,919	12,107	25,812
Cream	43,162	35	43,127
Buttermilk, whey	141	4,182	– 4,041
Butter, rendered butter	54,896	246	54,650
Hard cheese	21,879	90	21,789
Soft cheese	1,976	685	1,291
Milk, condensed or dried	39	6,454	– 6,415
Total	160,012	23,799	136,213

Consumption.—The consumption of dairy produce is thus seen to be 12,438,600 tons + 136,200 tons = 12,574,800 tons. In the absence of the necessary distinctions in the nett import of milk, in reckoning this consumption as nutriment we have allowed one-tenth for skimmed milk and to balance this we have included the whole of the nett import of cheese as cheese made from unskimmed cow's milk.

The consumption thus represents 478,500 tons of protein, 790,600 of fat, 571,700 tons of carbohydrates, and 11,633 milliard calories.

Contribution from Abroad.—A large part of the home-produced milk is due to imported fodder. In order to ascertain, therefore, what proportion of our home consumption of dairy produce we owe indirectly or directly to the foreigner, we must, in addition to the nett import of dairy produce already calculated, consider the nett import of fodder for milch animals.

The imported fodders are extremely varied. They include oil plants and oil seeds, the waste from certain agricultural produce, especially bran, and, among leguminous plants, vetches. The quantities imported can be seen at once in the trade statistics; we need only make additional calculations for bran, waste rice, and husks, as it would, of course, not be correct to consider only the import of waste and not the waste obtained from imported grain after grinding, husking, and malting respectively.

We will assume that, when ground, wheat gives 20 per cent. and rye 27 per cent. of bran. This bran we will include in full, although part of it is used as fodder for horses, and in compensation we will not take into account the bran obtained from the other imported cereals, which is also partly used as food for milch cows. We will assume the waste rice to be 25 per cent. of the unpolished rice, and the husks 30 per cent. of the brewing barley.

IMPORTS AND EXPORTS OF FODDER. AVERAGE FOR 1912, 1913.

Fodder.	Imports tons.	Exports. tons.	Nett Imports. tons.	Digestible crude protein.	
				p. c.	tons.
Oil plants and oil seeds ...	1,587,891	15,966	1,571,925	16·4	258,276
Bran	2,084,807	339,880	1,744,927	12·5	218,116
Waste rice	243,095	5,687	237,408	6·8	16,144
Oilcakes, oilcake meal, etc.	811,369	278,898	532,471	25·0	133,118
Beet chips (sugar completely extracted) ...	38,685	6,027	32,658	0·3	98
Distiller's wash and starch waste	67,849	4313	67,849	15·0	10,177
Brewers' grains, malt dust	206,515		202,202	12·0	24,264
Fodder beet, carrots, etc.	12,875	15,324	−2,449	1·0	−24
Sugar beet	106,866	136,255	−29,389	0·9	−265
Vetches	20,222	1,112	19,110	22·9	4,376
Total	5,180,174	803,462	4,376,712	—	664,280

It is very difficult to reckon fodder in terms of milk. It will probably be most easily done by reckoning the amount of digestible crude protein contained in the fodder and then comparing this with the crude protein contained in cow's milk (about 34 grams in 1 kilogram). The crude protein contained in the nett imports amounts altogether to 664,280 tons.

If we assume (allowing for loss, frequent irrational feeding, &c.) that every 70 grams of crude protein in fodder represents 1 kilogram of milk, the 664,280 tons of crude protein in the fodder would mean 9,489,700 tons of milk. Nearly half the cow's milk obtained in Germany is therefore due to foreign fodder.

Combining the two ways in which we draw dairy produce directly or indirectly from abroad, we arrive at a total of 136,200 tons + 9,489,700 tons = 9,625,900 tons. In actual nutriment, this represents 311,200 tons of protein, 392,100 tons of fat, 457,300 tons of carbohydrates, and 6,764 milliard calories. Of our total consumption, therefore, 65 per cent. of protein and 58 per cent. of calories come from abroad.

Consumption of Dairy Produce. Average for 1912, 1913.

Goods.	Home Production.	Nett Imports.			Consumption.	Actual Nutriment.							
		In form of		Total.		Protein.	Fat.	Carbo-hydrates.	Calories per kg.	Protein.	Fat.	Carbo-hydrates.	Milliard calories.
		Finished goods.	Fodder.										
	In 1,000 tons.					Percentages.				In 1,000 tons.			
Full Milk	8487·6	23·2	9489·7	9512·9	8510·8	3·2	3·5	4·8	650	272·3	297·9	408·5	5,532
Skimmed milk..	1723·4	2·6	—	2·6	1726·0	3·4	0·2	4·7	350	58·7	3·5	81·1	604
Buttermilk ...	256·4	-4·0	—	-4·0	252·4	3·6	1·0	3·8	390	9·1	2·5	9·6	98
Cream	*	43·1	—	43·1	43·1	3·8	22·6	3·8	2,410	1·6	9·7	1·6	104
Goat's milk ...	1287·9	—	—	—	1287·9	3·5	3·9	4·6	700	45·1	50·2	59·2	902
Butter	399·3	54·6	—	54·6	453·9	0·7	81·2	0·5	7,600	3·2	368·6	2·3	3,450
Skimmed milk cheese ...	147·1	—	—	—	147·1	33·8	11·1	4·1	2,590	49·7	16·3	6·0	381
Rich cheese ...	121·3	23·1	—	23·1	144·4	24·9	26·6	3·3	3,630	36·0	38·4	4·8	524
Sheep's cheese..	15·6	—	—	—	15·6	24·1	28·9	2·9	3,800	3·8	4·5	0·5	59
Condensed milk, etc.	*	-6·4	—	-6·4	-6·4	15·0	15·0	30·0	3,240	-1·0	-1·0	-1·9	-21
Total ...	12438·6	136·2	9489·7	9625·9	12574·8	—	—	—	—	478·5	790·6	571·7	11,633

Included in unskimmed milk.

(*b*) *Eggs.*

Home Laid Eggs.—73,374,868 hens and hen turkeys were counted on December 2, 1912, in the German Empire. Assuming that each hen lays on an average 70 eggs in the year, and that an egg weighs on an average 50 grams, we arrive at a total production of 256,812 tons of eggs. Of course, a small proportion of eggs are used for hatching or for industrial purposes. We can, however, ignore this, as we have not included the eggs of ducks, geese, plovers, sea birds, &c.

Nett Import of Eggs and Egg Parts.—A small proportion of home laid eggs are exported, and their place is filled from abroad. Some yolk of egg is also imported. (The small quantity of white of egg, imported almost exclusively for industrial purposes, may be ignored.) Altogether the imports amounted to 171,360 tons, the exports to 2,196 tons, and the nett imports to 169,110 tons.

Imports and Exports of Eggs. Average for 1912, 1913.

Goods.	Imports. tons.	Exports. tons.	Nett Imports. tons.
Eggs of poultry and game	165,752	445	165,307
Yolk of egg, beaten-up eggs	5,554	1,751	3,803
Total	171,306	2,196	169,110

Consumption.—The consumption of eggs thus amounted to 256,812 tons + 169,110 tons = 425,922 tons. In actual nutriment, this represents 46,800 tons of protein, 44,500 tons of fat, 2,700 tons of carbohydrates, and 618 milliard calories.

Consumption of Eggs. Average for 1912, 1913.

Goods.				Actual Nutriment.							
	Home Production.	Nett Import.	Consumption.	Protein.	Fat.	Carbohyd.	Calories per kg.	Protein.	Fat.	Carbohyd.	Milliard calories.
	In 1,000 tons.			Percentages.				In 1,000 tons.			
Eggs	256·8	165·3	422·1	10·8	10·1	0·6	1,410	45·6	42·6	2·5	595
Yolk of egg ...	—	3·8	3·8	32·3	49·0	5·6	6,100	1·2	1·9	0·2	23
Total ...	256·8	169·1	425·9	—	—	—	—	46·8	44·5	2·7	618

Contribution from Abroad.—As the feeding of native poultry with imported food is inconsiderable, and as the eggs laid here by imported hens are due to our food, we may put the contribution from abroad as equal to the nett imports. In actual nutriment, this represents 19,100 tons of protein, 18,600 tons of fat, 1,200 tons of carbohydrates, and 256 milliard calories.

Of our total consumption, then, 41 per cent. of protein and 41 per cent. of calories come from abroad.

6. *Summary.*

Our total consumption of vegetable foodstuffs before the war thus amounted to 1,252,300 tons of protein, 377,600 tons of fat, 12,335,200 tons of carbohydrates, and 61,666 milliard calories. Of this, 176,600 tons of protein, 201,700 tons of fat, 601,400 tons of carbohydrates, and 5,391 milliard calories came from abroad. Directly or indirectly, therefore, we obtained 14 per cent. of protein and 9 per cent. of calories from the foreigner.

TOTAL CONSUMPTION OF FOODSTUFFS. AVERAGE FOR 1912, 1913.

FOODS.	Consumption.				Contribution from abroad.			
	Actual Nutriment.							
	Protein	Fat.	Carbo-hydrates.	Milliard calories.	Protein.	Fat.	Carbo-hydrates.	Milliard calories.
	In 1,000 tons.				In 1,000 tons.			
	I.—VEGETABLE FOODSTUFFS.							
Vegetable Foods ...	1123·7	121·0	10005·5	46,653	160·7	10·1	982·7	4,778
Green Vegetables	75·3	12·5	376·3	1,944	3·3	0·5	16·3	84
Fruit	23·2	36·0	411·5	2,117	6·2	8·5	131·2	642
Sugar and honey ...	0·1	—	1187·5	4,745	0·0	—	−585·4	−2,338
Vegetable fats	—	184·4	—	1,715	—	158·9	—	1,478
Cocoa... ...	3·0	23·7	10·3	273	3·0	23·7	10·3	273
Alcoholic liquors ...	27·0	—	344·1	4,219[1]	3·4	—	46·3	474[2]
Total ...	1252·3	377·6	12335·2	61,666	176·6	201·7	601·4	5,391

Foods.	Consumption.				Contribution from abroad			
	Actual Nutriment.							
	Protein.	Fat.	Carbo-hydrates.	Milliard calories.	Protein.	Fat.	Carbo-hy-drates.	Milliard calories.
	In 1,000 tons.				In 1,000 tons.			
	II.—Animal Foodstuffs.							
Meat and fat...	431·9	1339·6	1·4	14,242	85·0	462·7	0·2	4,655
Fish	52·4	28·7	2·0	490	33·7	21·5	1·5	346
Dairy Produce	478·5	790·6	571·7	11,633	311·2	392·1	457·3	6,764
Eggs	46·8	44·5	2·7	618	19·1	18·6	1·2	256
Total ...	1009·6	2203·4	577·8	2698·3	449·0	894·9	460·2	12,021
	III.—Total Foodstuffs.							
	2261·9	2581·0	12913·0	88,649	625·6	1096·6	1061·6	17,412

(1) Including 2,716 milliard calories of alcohol.
(2) Including 273 milliard calories of alcohol.

Our total consumption of animal foodstuffs before the war amounted to 1,009,600 tons of protein, 2,203,400 tons of fat, 577,800 tons of carbohydrates, and 26,983 milliard calories. Of this 449,000 tons of protein, 894,900 tons of fat, 460,200 tons of carbohydrates, and 12,021 milliard calories came from abroad. We therefore obtained 44 per cent. of protein and 45 per cent. of calories from the foreigner.

Our total consumption of all foodstuffs before the war amounted to 2,261,900 tons of protein, 2,581,000 tons of fat, 12,913,000 tons of carbohydrates, and 88,649 milliard calories. Of this, 625,600 tons of protein, 1,096,600 tons of fat, 1,061,600 tons of carbohydrates, and 17,412 milliard calories came from abroad. We therefore had to thank the foreigner for 26 per cent. of protein and 20 per cent. of calories.

The daily consumption of foodstuffs per head of the population (66·6 million) before the war thus amounted to 92·9 grams of protein, 106·0 grams of fat, 530·5 grams of carbohydrates, and 3,642 calories. Of this, 25·7 grams of protein, 45·0 grams of fat, 43·6 grams of carbohydrates, and 715 calories came from abroad.

AVERAGE DAILY CONSUMPTION OF FOODSTUFFS. AVERAGE 1912, 1913.

FOODSTUFFS.	Consumption.				Contribution from abroad.			
	Actual Nutriment.							
	Protein.	Fat.	Carbo-hy-drates.	Calories.	Protein.	Fat.	Carbo-hy-drates.	Calories.
	In grams.				In grams.			
	I.—VEGETABLE FOODSTUFFS.							
Vegetable foods ...	46·2	5·0	411·0	1,916	6·6	0·4	40·4	196
Green vegetables...	3·1	0·5	15·5	80	0·1	0·0	0·6	3
Fruit	0·9	1·4	16·9	87	0·2	0·4	5·4	26
Sugar and honey ...	0·0	—	48·8	195	0·0	—	-24·0	-96
Vegetable fats	—	7·6	—	71	—	6·5	—	61
Cocoa... ...	0·1	1·0	0·4	11	0·1	1·0	0·4	11
Alcoholic liquors ...	1·1	—	14·1	173[1]	0·2	—	1·9	20[2]
Total ...	51·4	15·5	506·7	2,533	7·2	8·3	24·7	221
	II.—ANIMAL FOODSTUFFS.							
Meat and fats	17·7	55·0	0·1	585	3·5	19·0	0·0	191
Fish	2·2	1·2	0·1	2	1·4	0·9	0·1	14
Dairy produce	19·7	32·5	23·5	478	12·8	16·1	18·8	278
Eggs	1·9	1·8	0·1	26	0·8	0·7	0·0	11
Total ...	41·5	90·5	23·8	1,109	18·5	36·7	18·9	494
	III.—TOTAL FOODSTUFFS.							
	92·9	106·0	530·5	3,642	25·7	45·0	43·6	715

(1) Including 112 calories of alcohol.
(2) Including 11 calories of alcohol.

CHAPTER V

THE DEFICIT AND HOW TO MEET IT

1. *The Deficit*

WE now have to discover how great our deficit during the war will be as a result of the blockade which cuts us off from any foreign addition to our own food production and the probability of some shrinkage in that production during the war. There will be a deficit in two ways: first in connection with our consumption, and secondly in connection with our physiological requirements.

On an average for the years 1912, 1913 our consumption amounted to 88·65 billion calories, including 2·262 million tons of protein. In ascertaining what our consumption would have been if we had been able to go on as usual during the war, we must take the increase in population into account. As a rough estimate we may say that the consumption rises in the same proportion as the increase in population, and this is, of course, more likely to be correct than the supposition that in spite of the increase in population there is no rise in consumption. On an average for the years 1912, 1913 the population of the German Empire amounted to 66·6 millions; we will assume that at the outbreak of war it amounted to 68 millions, and leave out of consideration the absolutely incalculable alteration caused by the war;

this gives an increase in population of 2 per cent. We may then estimate that the consumption would have been 90·42 billion calories, including 2·307 million tons of protein, if conditions had remained as they were before the war. The physiological requirements for 68 million Germans amount to 56·75 billion calories (see p. 29) including 1·605 million tons of protein (see p. 38). This means that we overstepped our requirements in nutriment values by 59 per cent. and our protein requirements by 44 per cent.

At first sight these figures must be extremely startling, especially when it is to be remembered that they are carefully based on the best foundations at our disposal, but the cause of the difference between requirements and actual consumption can be detected. If we consider the home production and import of foodstuffs as consumption, that consumption, even with the greatest restraint and economy, must necessarily exceed the requirements, for on their way to the consumer these foodstuffs inevitably suffer considerable losses, and these losses are especially big where a highly developed middleman trade sends the foods through numerous hands, and sometimes by devious ways, to a place of consumption which may be quite close to the place where they were produced. A far more considerable cause is that as a prosperous nation we unnecessarily exceed our requirements and so squander a large quantity of foodstuffs.

When the total consumption is expressed in calories it exceeds the requirements more than is the case with protein; in the one case it is 59 per cent. and in the other 44 per cent. Therefore it may be presumed that we lose more of the other nutrients (fats and carbohydrates) than of protein, and indeed there are good reasons for this presumption. The foods which are rich in fat and carbohydrates are more generally allowed to perish than those rich in protein, as less care is taken to preserve them because they are cheap. A large part of the potatoes, green vegetables, fruit, and fat are lost before they reach the consumer, while pulse keeps good for a long time, and meat and milk are carefully preserved and more completely utilised.

In order to calculate our deficit we must first find what amount of foodstuffs we should be in a position to use as an isolated State dependent on our own production, without imports, but also without exports, if we continue our present way of living. On an average for the years 1912, 1913 we consumed 71·24 billion calories, including 1·636 million tons of protein from home production.

Had it not been for the war the home production could probably have been put at a higher figure, for it is unlikely that we should have met the increase in consumption caused by the increase in population solely with imports. It would be more cautious however, to allow for a decrease rather than for an increase in our home production. The next harvests will perhaps yield less, because of the dearth of skilled cultivators, of means of transport, and of manures; other sources of food may also prove less productive during the war, for instance, the yield of the North Sea fishery will be smaller; and in the parts of East Prussia and Alsace-Lorraine injured by the war the whole production of foodstuffs will suffer, apart from the stocks destroyed or carried off by the enemy. We fully compensate for these facts, however, if we assume that during the war the home production, instead of increasing by 2 per cent. (like the total consumption, perhaps), will decrease by 5 per cent. If we continued during the war our customary way of living we should thus be in a position to use from our own production 95 per cent. of 71·24 billion calories, including 1,636 million tons of protein), that is, 67·68 billion calories, including 1·554 million tons of protein.

This gives the following result:—

Nutriments	Calories, billions.	Protein, million tons.
Necessary	56·75	1·605
Actually consumed...	90·42	2·307
At disposal if present way of living is continued	67·68	1·554

It will be seen that what is still at our disposal during the war if we continue our present way of living is a long way behind our present consumption; 25 per cent. on the whole nutriment and 33 per cent. on the protein.

What remains to us stands in more favourable relation to what we require on physiological grounds than it does to the amount required for our present way of living; the nutrients exceed our requirements on the whole by 19 per cent., although the protein is still 3 per cent. behind our needs.

Our deficit is obvious. On the total nutrients we have a deficit only in connection with our present consumption; our actual needs are more than met. In protein there is a deficit, not only in relation to our present consumption, but also in connection with our requirement. Circumstances are therefore far more unfavourable in regard to protein than in regard to the whole nutriment. The cause of the especially large deficit of protein is lack of foreign fodder—the supply of such foods as meat and milk, which are rich in protein, has greatly diminished and the sugar, hitherto exported, which we have in their place contains no protein at all.

Our deficit must grow larger with every day we continue our present ways. Assuming, for example, that having made up our stores we live for six months as if there were no war, we should consume in those six months 45·21 billion calories, including 1·153 million tons of protein. There would then remain for the next six months 67·68 - 45·21 = 22·47 billion calories and 1·554 - 1·153 = 0·401 million tons of protein, but our physiological requirements for six months amount to 28·38 billion calories and 0·803 million tons of protein, so that in the second six months 21 per cent. of our total requirement of nutriment and 50 per cent. of our protein requirement would be missing. The situation is serious.

Meeting our deficit in total nutriment and in protein are two different things. So far as calories are concerned the task is comparatively easy. We have enough for our requirements, and in fact so much more that we can allow for the unavoidable losses between the producer and the consumer; all that we need do here, therefore, is to strive to bring our consumption of the calories at our disposal as near as possible to our ordinary consumption. So far as protein is concerned, the task is very much more difficult. We must endeavour to increase the amount of protein foods at our disposal by at least as much as will make up the missing 3 per cent. of our requirements and also the losses on the way from the producer to the consumer; the question of bringing the protein available still nearer to the amount of the present consumption is of secondary importance.

We can meet our deficit, not of course in the sense that we shall be able to use the same amounts of nutriment and protein as before the war, but yet so far that, in spite of the deductions for storage and the losses in forwarding, our calorie and our protein requirements shall both be fully satisfied. The means of doing this is a change in our standard of living suited to the situation created by the war. The home production of nutrients, and especially of protein, must be increased, but above all the great losses which have hitherto quite unnecessarily taken place must be avoided. In order to hold out against the English starvation scheme for as long as we like we have only to be firmly determined to adapt ourselves to the circumstances. The adaptation has been accomplished without difficulty so far as travelling is concerned and we have willingly exchanged our customs for those of our fathers. We are just as well able to satisfy the demands of the situation in regard to food, and so live more healthily than before. One thing is of course needful if the requisite measures are to succeed, that each shall sink his personal interests unreservedly in the common weal. To-day it does not matter whether a farmer or a manufacturer prospers or whether a company pays dividends, but we have all got to live. It is not a question of money at all, but of bread, meat, and potatoes. This is constantly being overlooked by many classes; for instance, certain persons interested in sugar are doing all they can to induce the Government either to permit the export of sugar or to keep up the price of sugar at home by fixing minimum prices or making similar regulations. Many people support these endeavours on the ground that money must be earned somehow. The argument is not sound. There is no need to earn money. We are all making sacrifices in these grave times, and the sugar producers and dealers will have to join us for good or evil. The fulfilment of their wishes would be a betrayal of the Fatherland's interests.

In order to do all that has to be done to meet our deficit we must make use of the gift which marks us out from other nations—capacity for methodical and determined action. It will not do to make a few regulations which appear to meet the deficit; the problem must be grasped in principle and as a whole. Then success will not be wanting.

2. *Storage*

The next thing to be considered is the storage of materials which may serve as food or for the production of foodstuffs in the future, and here we must pay special attention to the provision of protein, because in this case we feel the want of imports more than in the case of carbohydrates and of fats which can be replaced by twice the amount of carbohydrates.

Before the outbreak of war Ballod had already demanded the establishment of State granaries in which large quantities of grain could be stored in case of war. This demand has not been met. We must now take care, by means of storage, that scarcity shall not succeed to plenty if the war is a long one. In particular, we must see that there are sufficient quantities in hand of the grain and pulse which we shall want in the spring for seed. In the same way, extensive measures must be taken for the protection of pork, so that the unavoidable slaughtering of the greater number of our pigs may not lead first to a period of low prices and plenty of pork, and then to a sudden rise in prices and a big shrinkage in meat eating.

We must try to obtain from the neutral countries, so long as it is still possible, as many foodstuffs as we can, and also such materials as are used directly or indirectly in the production of foodstuffs—for instance, seeds, manures, and petrol for motors. The carrying capacity of shipping and railways is restricted by the war, therefore the standard which we must apply is that the more important goods must be imported before the less important, and the less bulky foods before those that take up much room, provided they are of the same value as nourishment. Oil cakes are more important to us than barley, because from the one milk is produced, and from the other pork, which we can more easily spare. Saltpetre is more important than phosphates, because our fields can more easily do without phosphoric acid for a few years than without nitrogen. The State must regulate the imports on this basis. The selection of the goods to be imported must not be left entirely to the merchant, for he is accustomed to look at the question from the personal and not from the national point of view. If it comes to the worst, we must act fearlessly, and, by restricting the imports and regulating the tariff, ensure that the forwarding of unnecessary goods shall not hinder the import of those that are necessary.

Whatever happens we must avoid sharing our foodstuffs with the foreigner. If there ever was anything which should be held on to with iron determination it is the prohibition to export foodstuffs issued immediately after the beginning of the war. We have a deficit of foodstuffs notwithstanding the fact that all those hitherto exported remain in the country, because our import of foodstuffs considerably exceeded our export. Now that the continued possibility of import is in jeopardy, every export means an increase of this deficit.

Under no circumstances and for no kind of consideration should any export of foodstuffs be permitted. The Imperial Government was therefore mistaken when it allowed itself to be temporarily persuaded to permit a limited exportation of sugar. The argument that the exported sugar would not be allowed to reach England was unsound; we have not got to keep our sugar in the country simply to inconvenience England, but because we need it in place of other foodstuffs which we used to import. It is equally a mistake to permit the export of grain to Switzerland out of consideration for that country; the wish to help a friendly nation ought under no conditions to increase still further the difficulty of feeding our own people during the war.

3. *Readjustment of Production*

Another matter of substantial importance in meeting our deficit in foodstuffs is the regulation of our production so as to provide the greatest possible amount of nutriment, including especially a sufficient amount of protein. The deciding factor is not the money value, but the nutrient value of what is produced. As soon as they realise the important bearing of an assured national food supply on the outcome of the war, our farmers will gladly subordinate their personal desire for a good bargain to the general interest.

Above all, we must strive in every way to obtain a good supply of foodstuffs. We must cultivate those plants which give the greatest amount of food per unit of area —for instance, turnips and potatoes; we must see that the necessary seeds are forthcoming for future sowings, for the spring sowing in 1915 to begin with, and also for the production of summer grain, pulse, and fodder plants; and we must counteract by every means in our power the difficulties which threaten the next sowing, lack of labour, draught animals, and manures. Ground hitherto unused must be made serviceable, by moorland culture, for agriculture and cattle rearing, and the yield of the land which is already farmed must be increased by inland colonisation. In connection with cattle rearing, the home-grown fodders, including those which have hitherto received little attention, such as beech nuts, acorns, and foliage, must be preferred, and every squandering of fodder—for instance, through keeping unprofitable feeders or allowing the fodder to decay—must be avoided.

We must not let ourselves be deterred by somewhat high expenses from doing what is necessary to produce the greatest possible food values. Such expenses should be regarded as war costs. The State, for instance, must see that the requisite steam and motor ploughs are forthcoming, and that the necessary nitrogenous manure is obtained according to modern chemical methods, even though the arrangements for this promise no kind of lasting profitableness.

Another thing we have to do is to make the fullest possible use of the foodstuffs we produce. In times of peace we did not pay sufficient attention to many foodstuffs which were at our disposal. A great deal was wasted because it was not gathered or not well preserved. Now we must strive to use everything down to the last scrap. For example, we must collect the lesser tree fruits and the berries which the country people in many parts of Germany despise, and make them serve as human food.

The principle of making the fullest possible use of all foodstuffs has been especially infringed by the employment of a very large number of them for technical purposes, so that they were either entirely or to a large extent withdrawn from the national food supply. Starch has been made from grain and potatoes and used chiefly for starching clothes; from the same foodstuffs methylated spirit has been made and used for driving motors and for illumination; edible fats have been made into soap.

We shall not be able to avoid all these losses in the national food supply in the future; for instance, we cannot do entirely without spirit for driving motor ploughs, where it again aids the food supply indirectly; but the use of foodstuffs for technical purposes must in any case be reduced to the indispensable minimum.

Another point in connection with the exhaustive use of the foodstuffs we produce is that any change which diminishes their nutrient value should be kept within certain limits; for instance, the following fact is of fundamental importance. The materials suitable for human consumption, especially grain and potatoes, feed a very much smaller number of people when through being used as fodder they are changed into meat and dairy products, than when we make direct use of them as human food. If these materials are used for fattening animals, only 50 per cent. of their available energy under the most favourable circumstances comes to man in the resulting animal footstuffs. With the milk, grain, and potatoes which a pig devours we could feed twice as many people as with the resulting pork.

The great loss in nutrient value which necessarily occurs in the production of meat and fat is proved by the feeding experiments on cattle carried out by Zuntz. In one series of experiments the animal digested daily an amount of food corresponding to 38,800 calories, from which only 9,119 calories in meat and fat were produced, *i.e.*, 23·5 per cent. of what was digested. In a second series 11,000 were produced from 40,257 calories, *i.e.*, 27·3 per cent.; and in a third series 11,196 from 39,286 calories, *i.e.*, 28·5 per cent. Even more unfavourable results are shown in the researches of Kellner. In these, 20·7 per cent., 22·4 per cent., and 21·5 per cent., averaging 21·55 per cent. of the digested food became meat and fat. Of course, we must remember that part of the food consumed by these animals (straw, hay, &c.) would not have been suitable for man, but large quantities of materials directly useful to man, such as seconds flour, starch, and sugar, were also included; in fact, without the addition of such "strong fodder" quick and effective fattening would not be possible. We have therefore to ascertain now how much material digestible by man the animals received, and what is the proportion of the resultant meat and fat to this part of the total fodder.

In the first two series of experiments by Zuntz each animal took daily an amount of such foodstuffs corresponding to 23,613 calories, and in the third series an amount corresponding to 23,195 calories, and the deposited meat and fat amounted in the three series to 38·6 per cent., 46·6 per cent., and 48·3 per cent. of these foodstuffs, which are as digestible by man as meat and fat. Thus between two-thirds and one-half of these foodstuffs is lost when they are used as fodder. The position as shown in the three series of experiments by Kellner is similar, though somewhat more favourable in view of a more extensive use of foods unsuitable to man. Here the meat and fat obtained represented from 50 per cent. to 55·8 per cent., an average of 52·9 per cent., of the foodstuffs digestible by man.

Similar results were obtained by von der Heide and Klein in their experiments in connection with pig fattening. Here, as is usual in pig fattening, almost the whole of the fodder consisted of materials digestible by man (dried potatoes, dried yeast, barley, fat), from the calories of which in two series of experiments 43 per cent. and 48·7 per cent. respectively were regained as meat and fat. All these experiments show what large quantities of food could be saved if the keeping of animals were restricted and the foodstuffs hitherto used as fodder eaten directly by man.

Other changes of foodstuffs also cause loss. This is especially the case in the preparation of butter; for the skimmed milk which remains and which contains the whole of the protein in the milk is to-day generally given to the pigs, and even in the future it will not be wholly available for human consumption. We must therefore restrict the making of butter and similar changes as far as possible.

Finally, the principle of the fullest possible use of all foodstuffs requires also that their decay shall be avoided as far as may be in any way practicable. The longer the goods are on the way from producer to consumer, and the more hands they pass through, the greater are the losses.

The means of avoiding such losses are good storing and preserving. We already use these means extensively for meat, milk, and other valuable foodstuffs; for instance, the cold storage of the larger towns makes it possible to preserve foodstuffs which were formerly wasted. Pickling and smoking are also useful ways of preserving meat, although meat so treated does not keep its nutrient value unchanged. We must now use all these methods of preservation to the fullest extent.

In the case of the less expensive foodstuffs also we have not taken sufficient care to avoid loss. Grain and flour are not always stored in a suitable manner; it is well known how greatly potatoes lose in food value if they are carelessly stored; a very large amount of green vegetables and fruit goes bad. Now we must use every means of shielding these foodstuffs from decay, potato drying must be more widely employed, more green vegetables must be stored for the winter, or bottled, and fruit, including wild fruit, must be made into jam.

4. *Readjustment of our Standard of Living*

The third and last thing necessary, in order that our deficit in foodstuffs may be met, is a suitable readjustment of our manner of living. A drastic change is by no means desirable; minor alterations which generally only mean a return to the good old customs of former days, are all that is required.

A few alterations in our diet must be considered first. At present, especially in our cities, a great deal of meat and fat (including butter) is eaten; the consumption of these articles has increased enormously in the last ten years. In view of this fact we must clearly understand that protein, fat, and carbohydrates are all equally able to afford the energy consumed in every kind of work, and that this part of our requirements can be just as well supplied by the more abundant carbohydrates as by protein and fat. Of course, only protein can replace the body-tissue as it gradually wears itself away, but the body does not need protein either in the quantities generally taken nor necessarily in the form of meat.

It therefore follows that, without committing ourselves to the monotony of vegetarianism, we can quite well let the vegetable foodstuffs take a more prominent position in our diet, and further that many of us can restrict our consumption of meat and fat, as well as of vegetable fat, without harm. We can thrive excellently on dinners where puddings partly take the place of meat and on breakfasts where butter is replaced by jam, and the result of such changes in our bill of fare is that we can make an incomparably better use of the provisions in hand.

The change to a diet altered to this extent need not be made immediately. If in order to make a better use of our foodstuffs we now kill some of our pigs, we shall soon have more meat than we want; but we should do well to accustom ourselves at once to a decreased consumption of meat, such as the high prices of the last few years have indeed already threatened. The State and public bodies ought, therefore, by buying up and preserving large quantities of pork, to check the present excessive consumption of meat and thus at the same time secure stores for the future which will counteract any sudden scarcity.

The decay or squandering of foodstuffs in the household must especially be avoided. The arrangements for keeping food in private houses are often extremely defective; a great amount of nutriment is lost in peeling potatoes and in the preparation of food generally; insufficient attention is paid to preserving and using the remnants; and fat is dealt with in a particularly extravagant way. What enormous quantities of the most valuable foods are thrown away or rinsed from plates, dishes, and cooking utensils has been proved by Rubner, who found that the Berlin sewage contains an amount of fat equal to about 20 grams daily per head of the population. There must be an improvement; we must realise that in the interests of the individual as well as of the national food supply economical housekeeping is imperative.

Apart from diet, there are many ways in which our daily life can help to meet the deficit in foodstuffs. The starching of clothes, for instance, only means that rice and potatoes, that is, human foods, are being used to make our clothes less comfortable, though in the opinion of many people more beautiful. It would be better if we limited the starching of clothes in order to gain foodstuffs. In many parts of the country coke or coal are used indiscriminately for heating. Those who use coke are aiding the food supply, for the ammonia obtained in making coke is a valuable manure, and the benzoline which is also obtained from it is used for driving motors. There are many other ways in which we could help.

5. *The Necessary Measures*

If the necessary steps are taken we can meet our deficit in foodstuffs without difficulty. But how are we to take the necessary steps? Three ways can be thought of: State legal regulation, State and parish administrative measures, and instruction of the public. According to their point of view, one man will lean more to this and another more to that mode of procedure. In reality all three must work together.

Within certain limits legal measures are indispensable. If we are to prevent valuable foodstuffs being sent abroad there are no other means than prohibitions of export. The use of bread corn as food for pigs or in distilleries is wrong and there is nothing to be done but to forbid it. It is a good thing that the law of August 4, 1914, authorising the Federal Council to take economic measures, has made it possible to issue such orders without great loss of time.

It may under certain circumstances be necessary to prescribe maximum or minimum prices. It is less a question of preventing speculators making an improper profit or assuring the producers a suitable income than of leading the public in the right way in connection with consumption. Maximum prices may actually cause a certain foodstuff, the liberal use of which is desirable, *e.g.*, sugar, to become extremely scarce. Lowest prices may have the effect of preventing too great a use of a foodstuff, *e.g.*, meat, at the expense of the future. Such fixings of price are particularly valuable when the use of one foodstuff has to be substituted for another, *e.g.*, rye which we have in plenty for wheat which is scarce. Great caution is of course necessary in fixing maximum and minimum prices lest undesirable subordinate effects should occur.

Administrative measures will be necessary in certain cases. If larger quantities of pork are to be withdrawn from present consumption by being bought up and preserved, if the spring sowing is to be assured by the storing of seed corn, if the apparatus for potato drying is to be erected on a large scale, if the preparation of nitrogenous manure from the nitrogen of the air is to be carried on to a sufficient extent, the only way of securing that the necessary steps shall be taken is for the State and local authorities to intervene. They must buy up the pigs, store the grain, and support by loans the setting up of potato drying apparatus and the erection of nitrogen factories.

The most important thing is the instruction of the public, and here it is a question of influencing the producers as well as the consumers. We should advise the farmers to make the best practical use of the existing manures and pay full attention to the farmyard dung and vegetable manure, the merchants to procure certain goods from neutral countries, the colliers to encourage the use of coke by low prices, the consumers to eat more vegetable food. It is important to make this teaching as effective as possible and to enlist the support of every suitable class—agricultural societies, trade unions, the Women's National Service, as well as the Press in every direction.

If we act in this way we shall be fully able to meet our deficit in foodstuffs and to wreck the English scheme to starve us out. The details of what we have to do will be examined in the following chapters.

CHAPTER VI

Prohibitions of Export

In order that our deficit may not grow greater, every reduction in our store of foodstuffs must cease; no foodstuff and no material for the production of such important articles as fodder and certain manures must be sent abroad.

For this reason, three Imperial ordinances were published on July 31st, the first forbade the export of all materials for the maintenance of animals, including straw and fodder, the second the export of all animals and animal products, and the third the export of certain important raw materials. All three empower the Imperial Chancellor to draw up a list of the articles excluded from export and to permit exceptions from the general prohibition, and on this authority the Imperial Chancellor has declared the export of any and every kind of food and fodder and some important manures as forbidden. Exceptions have been allowed to the general prohibition; most of them were harmless, but weighty considerations condemn the breach of the prohibition permitted in the case of grain and sugar.

1. *Grain*

Grain should under no consideration be exported. It is much to be regretted that the Imperial Government out of friendly regard for Switzerland permitted 250 wagon loads of grain to be exported thither. The decision can be easily understood. Switzerland is not a grain-producing country and is almost entirely dependent on foreign imports for bread; there, indeed, although any restriction of individual freedom is especially distasteful to the republican consciousness, any use of bread corn as fodder is punished with fine and imprisonment. All the same, the wisdom of any liberal export of grain to Switzerland is extremely doubtful. If the principle that, out of friendly feeling, we may give some of our food to neutral neighbours should become generally recognised, the consequences would be quite incalculable. It might happen that another State, finding itself in a like embarrassment, would take the refusal of a similar export as an unfriendly act, and so what was at first a voluntary concession either become a necessity or cause unpleasantness which could have been avoided if we had refused from the beginning to allow any breach in the prohibition to export foodstuffs. It may be added that Switzerland is not in such dire need that it is necessarily our duty to help her with grain. Switzerland is a small neutral State with correspondingly small needs, and she can obtain all she requires through Italy. We, on the other hand, are a numerous people, with an enormous requirement of food, and very probably shall have to manage during the war without the greater part of our imports of food and fodder. Under these circumstances no consideration for Switzerland or for any other nation should induce us to infringe our prohibitions of export.

No political considerations demand the surrender of vital interests. Our neutral neighbours have acted on this principle, and without regard to us have forbidden the export of everything which is indispensable to themselves; for instance Denmark has forbidden the export of barley which is important to our pig raising and essential to the Danish cattle rearing. None of us has taken the action of these countries amiss. Our neighbours will understand when we answer requests for an exception to our prohibitions of export by pointing out that our own food supply does not permit the concession. Where our food supply would not be endangered, for instance in an exchange of foodstuffs (which is not only in view but already fully arranged) these considerations would naturally not come into account.

2. *Sugar*

It is also particularly important that no sugar should be exported. Unfortunately, the prohibition of sugar export has already been infringed. For the moment, of course, the danger of a large sugar export is averted; but it is only too probable that endeavours in this direction will soon become manifest again.

In September the sugar producers and dealers made more and more urgent demands that the Government should permit the export of sugar up to the amount of the export in 1913 (1·1 million tons). At the beginning of October the Government acceded to these demands and declared itself willing to permit the export of sugar from time to time until the limit of 1·1 million tons should be reached.

The *Norddeutsche Allgemeine Zeitung* supported this concession on the ground of the difficult position of the sugar industry. "It seemed the most practical solution of the difficulties which had arisen," it wrote, "to maintain as such the prohibition to export sugar, but on each single consignment to apply for the release of a quantum for export which would satisfy the needs of neutral countries in the same degree as heretofore and leave the desired sale to our industry, so far as might be possible without damage to those interested in the home requirements. In the last trade year we produced in Germany in round figures 27 million double zentners[1] of sugar (reckoned in raw sugar); 4 million double zentners of this is assumed to be stock in hand to-day. If we estimate the result of the current year to be at least as good as the last, we shall have a total stock of sugar amounting in round figures to 30 million double zentners. Last year a little over 11 million double zentners of sugar of all kinds was exported. If a similar amount remains free for export the trade's freedom of action will not be encroached upon, although of course it must be remembered that the loss of the enemies' markets will prevent the export from taking full effect. No restrictions other than the control implied in this special permission are contemplated so that the field of industry and commerce will not be limited by the authorities. One advantage of such a course is that there can be no question of breaking and cancelling contracts. The Government must, of course, reserve to itself the right to withhold the export as soon as sugar is no longer available at home at the usual price or if it is withdrawn from home consumption (either for human food or for fodder) in an uneconomical way. If this should happen we shall not hesitate to prevent the export or to introduce maximum prices."

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[1] Double zentner, the metric hundredweight = 100 kilograms = 220·46 lb. avoirdupois; 2 hundredweights avoirdupois = 224 lb.

This opinion is extremely contentious; even the argument that the sugar industry is in a difficult position cannot be defended; and further, since all our industries are limited to the home markets at present, the lot of the sugar industry is not a particularly unfavourable one; in fact its position is extremely favourable, for owing to the present economic situation it would, if it acted rightly, have the certainty of being able to dispose of its whole production in the home markets. All that has to be done is to make use of the many modern means of propaganda to draw the attention of the public to the value of sugar as a food; to support the jam and fruit syrup industries, and above all to forgo too high prices —then sooner or later, in view of the fact that we are at present limited to our own sugar, the whole of the production could be disposed of in the country. With this object we need only aim at the amount of the American sugar consumption (36 kilograms per head of the population) and not that of the English (40 kilograms). The large consumption of sugar in England was brought about by low prices, and how much these can contribute to a rise in consumption was seen here in 1904 when the removal of the export premiums and the lowering of the excise caused a sudden drop in the price of sugar. The price of refined sugar averaged 55·9 marks[1] per double zentner in the years 1901 to 1903 and sank to an average of 39·9 marks in the years 1904 to 1906, while the consumption per head rose from 12 kilograms to 16·1 kilograms.

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[1] Note the German mark = 1 shilling.

PRICE AND CONSUMPTION OF SUGAR IN THE GERMAN EMPIRE, 1901–06.

Year.	Price of Refined Sugar per double zentner. Marks.		Consumption per head. Kilograms.	
1901 ...	57·9	Average 55·9	12·3	Average 12·0
1902 ...	56·5		11·6	
1903 ...	53·3		12·0	
1904 ...	39·8	Average 39·9	17·2	Average 16·1
1905 ...	43·0		14·4	
1906 ...	36·8		16·6	

Thus a decrease of 29 per cent. in the price of sugar has gone hand in hand with an increase of 34 per cent. in the consumption of sugar. Here is the means by which the sugar producers can dispose of their produce. Of course it is easier and commercially more advantageous for them to dump part of the sugar abroad and obtain high prices for the rest owing to the pressure of the considerably increased home requirements due to the dearth of fats, but these private economic considerations must give way to the general interest, and in any case the Imperial Government should pay no heed to them.

The infringement of the prohibition to export cannot be supported, as the *Norddeutsche Allgemeine Zeitung* affirms, on the ground of consideration for the neutral countries. This consideration, as has been shown, must not induce us to permit the export of foodstuffs which are indispensable to us. The only countries concerned, Holland, Denmark, Sweden, Norway, and Switzerland, did not take about 1,100,000 tons of sugar from us in 1913, but only 119,000 tons altogether; England alone, on the other hand, without her colonies, took 842,000 tons. Thus it is clear that the demands of the interested groups that the export of sugar shall be permitted up to the amount of 1·1 million tons can only mean that it is their intention to send the greater part of this sugar directly or indirectly to the English market.

The fact that in September England prohibited the importation of German beet sugar need not be taken seriously. If she could get it through Denmark or Holland she would take it from them gladly; her declaration against the German sugar only has the transparent object of distracting our attention from the actual situation, and this has since been proved by the decision of the British Board of Trade to require no certificate of origin of sugar coming into England from Holland, Denmark, Sweden, or Norway. Besides this, the English sugar supply is at least indirectly dependent on the German export. England has declared that in future she will meet her sugar requirements with American cane-sugar; but America, who can just meet her own needs from her own production, can only send cane-sugar to England if she receives the same amount of beet-sugar from us. An import of American cane-sugar by England would therefore only mean an indirect import of German beet-sugar made dearer by double ocean freights.

The third ground on which the *Norddeutsche Allgemeine Zeitung* seeks to justify the permission to export is that the export of 1 million tons of sugar would not mean damaging "those interested in the home requirements." If by those interested in the home requirements is meant the sugar dealers, this expression would be appropriate; but if, as one would naturally suppose in an official organ, by those interested in the home requirements is meant all the consumers, the assertion is open to question in the present, and in the near future is, according to all human judgment, incorrect. Since a large part of our import of food and fodder is blocked, for instance 3 million tons of barley, 2 million tons of wheat, 1 million tons of maize, and 1½ million tons of oil plants are missing, we urgently need the sugar hitherto exported in order to lessen this deficit. Above all, it must serve as a substitute for those foodstuffs the absence of which will make itself felt first, most deeply and most certainly, namely, fats of all kinds. We shall lose not only the whole of the import of 400,000 tons of table fats, but our home production of fats (lard, bacon, milk) will be considerably diminished owing to the dearth of fodder. Sugar must help to replace the enormous calorie contents of these missing fats.

That there are no practical difficulties in the way of increasing our sugar consumption up to the amount of our total production, *i.e.*, up to 36 kilograms per annum per head of the population, is shown by the example of England and the United States (p. 98). In view of our habitual diet, such an increased consumption of sugar could not, of course, be brought about between to-day and to-morrow, but the desired enlightenment of the general mass of people will very soon be materially aided by the pressure of circumstances, and especially by the rising prices of fats and butter. Sugar is an extremely durable foodstuff, and we should have cause for thankfulness if reserve stores of sugar were at the nation's disposal. Considering our general deficit in foodstuffs these reserves would be welcome even if our next beet crop were as good as the last. The supporters of the sugar export seem to take this for granted, but it is only too improbable. Nowhere will the dearth of skilled labour and manure during a long war (such as we must expect) be felt so much as in connection with the exacting beet.

Yet another reason for the permission to export is whispered about as an important secret. The *Norddeutsche Allgemeine Zeitung* has not adopted it, and does well not to do so. It is affirmed that the export of 1·1 million tons of sugar, worth in round figures one-quarter milliard marks [£12,500,000], is desirable in order to improve the rate of German exchange in the neutral markets; the foreign buyers of sugar would settle their debts with German exchange and this would raise the rate. This assertion is entirely wrong.

The momentarily depressed rate of our exchange abroad would be disquieting if it rested on a lack of confidence in our solvency, but there can be no question of this in view of the course of the war up to the present. The low rate is simply due to the fact that we are drawing many more goods from abroad than we can give in return and that therefore we have more debts than receipts. As every intelligent foreigner knows this, the low rate of exchange does not mean a politically undesirable depreciation of our credit, but merely the enhanced price of the goods obtained from abroad on bills of exchange. Such an enhancement is an incomparably lesser evil than giving away large quantities of an article which is indispensable to our food supply, therefore our merchants must think of some other means of raising our rate of exchange abroad.

The *Norddeutsche Allgemeine Zeitung* makes the fundamental mistake of looking at the question of our sugar supply apart from the whole question of our food supply. If we only had to consider our sugar requirements we could accede to the wishes of those interested persons without detriment, but as our sugar consumption must be considerably increased in order to meet our total food requirements, to allow the export would be to commit a crime against our national food supply.

This, and not the possibility that some of the exported sugar may directly or indirectly go to meet the English requirements, is the deciding factor. The prohibition to export sugar must be maintained without interruption, not in order that there may be a shortage in England, but because we need the sugar for our own food.

The weighty objections to allowing the export of the sugar cannot be removed, as the *Norddeutsche Allgemeine Zeitung* proposes, by withholding the export as soon as sugar is no longer available at home at the usual price. According to the principle of supply and demand, a rise in the price of sugar is only to be feared when the large quantities released for export have disappeared from our market and then it will be too late to forbid the sugar export.

Some of the authors of this work, together with certain distinguished persons, have laid these points of view before the Imperial Government and the relevant Prussian Ministers, and we are glad to state that our representations were followed by the official declaration that the export of sugar would not be permitted to the proposed extent.

CHAPTER VII

PLANT CULTIVATION

1. *Plants to be Cultivated*

In connection with plant cultivation, the present time sets us a clearly defined task. We must not let the deficit caused by the loss of imports grow greater; and therefore we must take care that the home production of plants suitable for food or fodder does not decrease. We should rather strive to lessen the deficit as far as we possibly can by increasing our production of edible plants.

The first thing to be done is to cultivate those plants which will give the greatest yield, including where possible the protein which is now scarcer than any other nutrient. It has been proposed that pulse, that is, beans, peas, and lentils, should be cultivated on a larger scale than has hitherto been done.

Pulse is distinguished by its high protein content, and in this it is almost equal to meat. On an average for the years 1912, 1913, we imported (after deducting exports) 251,000 tons of peas, 31,000 tons of beans, and 28,000 tons of lentils, chiefly from Russia and India. Under these conditions it seems that it would not only be worth the farmer's while to extend the cultivation of pulse, but that it would be a meritorious action in connection with our food supply.

Pulse, however, has the peculiarity of not giving a sure crop everywhere and every year, so that the extension of its cultivation must be undertaken with caution and with due regard to the character of the locality. It can be recommended where the natural conditions are favourable, but a general counsel to plant more pulse would be unwise.

It has further been suggested that the cultivation of roots, that is, turnips and potatoes, should to a greater extent be replaced by the cultivation of grain. The grain at our disposal has decreased; we especially miss the 2,000,000 tons of wheat hitherto imported, and even though we have in its place the exported (1913) 600,000 tons of rye, there still remains a deficit, to meet which the use as fodder of all rye suitable for human consumption has been forbidden. Large quantities of barley and maize which we used to import for fodder are also lacking. On the other hand, we were able to export about 1,100,000 tons of sugar made from home-grown beet, and we use only about a third of our potatoes directly as human food, while the rest is used for fodder, distilling and the making of starch, though a great deal is lost through rot. There thus seems to be nothing more urgent than partly to replace our superfluity of these plants by the cultivation of grain.

Nevertheless, this cannot be recommended. Root vegetables not only yield more money to the same area than grain, though this is at present a matter of secondary importance, but a larger amount of nutriment, and in fact, though one would hardly expect it in view of the small protein contents of these plants, because of the greater yield on the same area, a larger amount of protein, though this is not all available for human nourishment.

HARVEST YIELD OF GRAIN AND ROOTS. AVERAGE FOR 1909—1913.

Cultivated Plant.	Crop, excluding seed corn, per hectare[1] double zentners.	Digestible Protein per double zentner. kilograms.	Calories per double zentner.	Protein produced per hectare[1] kilograms.	Nutriment yield per hectare.[1] Milliard calories.
Rye	16·5	9·6	312,000	158	5·1
Wheat	18·7	13·2	314,000	191	6·5
Potatoes	117	1·1	82,000	129	9·6
Sugar beet	273	0·9	87,000	246	23·8

The very much larger crops from roots therefore not only compensate for the greater calorie contents, but also to some extent for the far more important protein contents of grain.

The sugar-beets furnished nearly five times as many calories as rye and one and a half times as much protein, though certainly not all the protein is available. Where it is contained in molasses and chips, of course, it is only used for feeding cattle, so that only about 30 per cent. of it returns in the form of meat and milk, but in spite of the loss through this transformation one hectare of sugar-beet furnishes half as much protein for human nourishment as one hectare of rye. The relative values of the straw and the leaves as fodder do not make much difference to this result.

The cultivation of root crops has also some particularly advantageous consequences; in fact, it may be described as the foundation of intensive agriculture.

This is obvious when we remember what the introduction of beet cultivation effected. The increase in the yield was

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[1] Note 1 hectare=2½ acres (2·471 acres).

in wheat	between	4 and 5½	double zentners	per hectare.
in rye	,,	3 and 4	,,	,,
in barley	,,	5 and 7	,,	,,
in oats	,,	3 and 4	,,	,,

and this was not in one year only, but on an average of several consecutive years. This great increase in cereal crops was not by chance.

The products of the agricultural industries due to root cultivation (sugar, spirit, starch, etc.) only take from the farmer materials which are in the air, for they consist only of carbon, hydrogen, and oxygen. All the mineral plant constituents and part of the nitrogen are left to the farmer in the abundant remainders from these industries (molasses, chips, distillers' wash, pulp, tops, leaves, plants) which can be used as fodder or contribute to a lasting increase in the fertility of the land.

On the introduction of beet cultivation, therefore, more and better cattle could be raised, these cattle produce more and better dung, and the fields dressed with this were quite exceptionally enriched with the so-called "old strength." By cultivating root crops the rotation of crops allowed a fuller use of the ground, which caused a better yield of all plants. The root crops needed richer manure, planting in rows, and hoeing, and compelled these methods of improved agriculture and increased ground cultivation to be transferred to all other plants.

Root cultivation proved similarly useful in connection with cattle-rearing, for it caused a division of work between the farms with agricultural industries and those without such industries. The manufacturing farms could not successfully carry on cattle-rearing for any length of time with the fodder furnished by factory waste and therefore they became customers for the young cattle; these were bred and raised in the districts where there were no agricultural industries, while the manufacturing farms contented themselves with fattening and milking. The great need of draught animals required by the manufacturing farms encouraged the rearing of heavy horses and oxen.

Another beneficial result of root cultivation was its influence on business organisation and agricultural bookkeeping, for in many cases it caused an obsolete rotation of crops to be abandoned and a more thorough audit and oversight of the business to be adopted.

The increased use of all the improved methods of cultivation due to root cultivation necessitated raising the more exacting but more prolific kinds of all plants, so that a further increase in the yield was brought about.

Apart from this purely agricultural progress, root cultivation was also the cause of a highly-developed agricultural machine industry in Germany and, owing to the rise in the whole agricultural production, of an enormous increase in goods traffic on our canals and railways, so that it promoted, not only the agriculture, but also the trade and finances of the State in a high degree.

Thus to limit root cultivation in favour of grain would not be to increase our food supply but rather to decrease it, and would result in great injury to our agriculture as well as to our whole economic life.

2. *Seeds*

It is of great importance to our agriculture that the necessary seedcorn, etc., shall be secured for future sowings and first of all for the spring sowing of 1915.

The first thing to be considered is the summer grain. The limitation in the available draught animals and labourers caused by the war has frequently hindered the sowing of winter corn, and in many parts of East Prussia and Alsace-Lorraine damaged by the enemy sowing could not take place. Therefore, there must be an extension of the sowing of summer corn. As far as the amount of yield is concerned, this could be done without hesitation, for there are now varieties of summer grain suited to the different conditions of ground and climate which yield a prolific crop; we have only to take care that the necessary amount of seedcorn is forthcoming at the next spring sowing.

Summer ryes which are worth special attention are F. von Lochow's Petkus summer rye and Jäger-Könkendorf's summer rye.

Among summer wheats, red Schlanstedt summer wheat and its different varieties, Heines Jafet summer wheat, Svalöf's Pearl, Noah summer wheat, &c., are best for good ground and cultivation. Where the conditions of ground, manure, and rainfall are less good, Lohmann's Weender Galician cob wheat, the summer wheat of H. Müller, Kittnau, West Prussia, and the Silesian bearded summer wheat are worth special attention, and for very light ground Lupitzer Sand summer wheat and for heavy ground in a dry situation the Green Mountain summer wheat.

The cultivation of summer barley need not be only for the sake of brewing barley, but could provide fodder barley on ground which is no longer to be relied upon for oats and so replace the important import of Russian fodder barley. Where oats do not bring larger and more certain crops than barley, we should do well to extend the cultivation of fodder barley more widely and to use for this purpose the more prolific varieties of long-eared barley which are generally cultivated for brewing purposes.

It is very important that the varieties which best suit the purpose, ground, and climate should be selected and the seed obtained as far as possible from the place where it was raised and carefully cleaned and sorted for sowing.

The seed for spring sowing of pulse, *i.e.*, peas, beans, and lentils, must also be secured. Since our great import of pulse has ceased (p. 104), there is a danger that the stocks in the country may be all consumed before next spring, and so the indispensable seed be missing.

No less care must be taken to provide the seeds for fodder plants in good time, for we have hitherto imported many seeds, especially from Russia, for instance, on an average for the years 1912 and 1913 (after deduction of export) about 40,000 tons of clover and grass seed.

Our agriculturists must see that the necessary quantities of fresh seeds for fodder plants are forthcoming, and that the seeds are capable of germinating and free from dodder. The seeds should if possible be obtained only from clover fields which are recognised by the German Agricultural Society or the seed departments of the Agricultural Chambers or other seed cultivation organisations, with the assistance of the seed cultivation societies or the seed departments of the Agricultural Chambers.

Securing the necessary seed for summer grain, pulse, and fodder plants will hardly be attained by giving advice. Such advice frequently does not reach those for whom it is intended and one cannot rely on its being followed, especially in the smaller businesses, and therefore State organised precautions are absolutely necessary.

The Agricultural Administration should induce the Agricultural Chambers to ascertain the requirements of good seedcorn in their districts and should also induce them to provide it. Special consideration should be paid to the small farms; if necessary, they should receive monetary aid in buying the necessary seed.

In August, two of the authors of this book laid before the Prussian Minister of Agriculture a request that he would endeavour to secure pulse and clover seed for the spring sowing, but unfortunately this request does not yet seem to have had any result.

3. *Labourers, Draught Animals, Steam and Motor Ploughs*

It is very important that the necessary human, animal, and mechanical aids shall be forthcoming for the next planting of our fields.

The dearth of labourers for the harvest and sowing this autumn proved to be less than had been feared. Until the spring we shall hardly be able to speak of a lack of labourers. The superfluous industrial labourers drift gradually of their own accord into agriculture and necessarily become familiar with agricultural work. Out of the large number of prisoners of war (already far more than half a million) we may also obtain many experienced farm workers.

The dearth of draught animals is also not so great as was at first thought. We may reckon that about half a million horses have been requisitioned for the army and that about 130,000 imported horses are missing on the basis of an average for the years 1912 and 1913 and assuming that we receive no horses from Belgium. As our normal stock is a little over four and a half millions, about 14 per cent. of our horses are wanting.

In the districts in which horse breeding is carried on the requisitioned horses have been nearly all replaced by harnessing the foals earlier. To a large extent cattle, not only oxen and bulls, but above all cows, will take the place of the missing horses. With skilful handling these animals can be trained for ploughing in a short time and the winter gives sufficient leisure in which to drill them in pulling. Many researches have proved that a moderate use of milch cows for ploughing does not appreciably affect their yield of milk; it is only necessary to balance the consumption of energy caused by the work with additional fodder, and for this purpose we have the plentiful supply of fodders containing little protein (turnips, potatoes).

An increased use of steam and motor ploughs can also help. The fullest possible use of all existing steam and motor ploughs must be made. The great landed proprietors who indeed do not make full use of their steam and motor ploughs must help the smaller proprietors in their neighbourhood by lending their ploughs on hire; care must be taken that the steam ploughs belonging to contractors shall not stand idle; the hundreds of motor ploughs, now lying ready in the factories, must be put at the service of the farmers; where a man's means are insufficient, societies, if necessary the State, must render aid. A gratifying beginning in this direction has already been made.

For the steam ploughs, and where there are power stations for the electric ploughs, there will be no lack of material for the production of driving power, but the case is different with the motor ploughs, which almost without exception have hitherto been driven by petrol and benzoline. We need not depend on a continued import of petrol from neutral countries, from Roumania particularly, because the benzoline produced in our coke manufactories is quite as good as petrol. These trades were partially stopped owing to the scarcity of labour and means of transport after the mobilisation, and it is now of the greatest importance that they should be set going again to their full extent and if possible to a greater extent. This naturally implies that additional uses will have to be found for coke besides the extremely restricted use in blast furnaces and smelting works. These would include house fires but especially its use in locomotives. If everyone who is able to do so uses coke as far as possible, and this must be encouraged by moderate prices, we shall obtain not only considerable quantities of benzoline, but also of ammonia, which is so important as a manure. The collieries will have no difficulty in furnishing the coal suitable for the preparation of coke, which is also rich in volatile distillation products.

We may also expect to obtain power for driving the motor ploughs from the more modern methods for the utilisation of heavy oils and petroleum. The method of making heavy oils completely combustible by the addition of soap-suds has already passed the experimental stage and ought to help to make up for the scarcity of petrol.

Another product, which was widely used in the first months of the war, is methylated spirit. Five kilograms of petrol are fully replaced by 8·5 kilograms of 95 per cent. spirit if a moderate quantity of benzoline is mixed with the spirit.

A motor plough working 10 hours a day and ploughing deeply 4 to 4·5 hectares does the work of 28 oxen; it requires about 150 kilograms of alcohol daily, in 150 work-days 22,500 kilograms, corresponding to about 280 hectolitres[1]; 1,000 motor ploughs would need 280,000 hectolitres, *i.e.*, nearly one-sixth of the amount of alcohol available in Germany in 1913 for industrial purposes. The question now is: Is it economically wiser to turn a considerable portion of our potatoes into alcohol and so make them useful for the cultivation of the ground, or to use them as fodder for draught animals?

In connection with this question we may make the following calculation. A motor plough replaces 28 oxen; where deep ploughing is required it does more than they can. According to Fischer, from four to five oxen are necessary to plough half a hectare 18 centimetres[2] deep in one day, at the same time loosening the subsoil for 13 centimetres, that is, as intensively as a motor plough; this would mean the ploughing of one-ninth of a hectare as the day's work of one ox. As a motor ploughs from 0·4 to 0·45 hectare an hour, in ten hours it would plough 4·25 hectares, and so equal the work of 36 to 40 oxen.

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[1] 1 hectolitre = 100 litres = $21\frac{7}{8}$ gallons approximately.

[2] 1 centimetre = $\frac{2}{5}$ of an inch approximately.

Leaving the intensive working of the field out of the question and reckoning a motor plough as equal to 28 oxen, as is done in a number of estates near the frontier, we can reckon the consumption of human foodstuffs by the motor plough and by the oxen in this way. To produce the 150 kilograms of alcohol required by the motor plough, theoretically 263 kilograms of pure starch are necessary, actually about 300 kilograms in view of the inevitable losses in distilling. An ox weighing 700 kilograms and doing moderate work, as is here supposed, needs, according to Kellner, an amount of fodder which is equivalent to 6·8 kilograms of starch; the 28 oxen therefore require 190 kilograms of "starch" daily, or 28,500 kilograms in 150 working days. The oxen must also be fed on the 215 days of rest with 5 kilograms of "starch" daily, making a total of 1,075 kilograms for each and 30,100 kilograms for the 28 oxen. Adding this to the consumption on working days (28,500 kilograms), the total yearly consumption is 58,600 kilograms, or 391 kilograms for the 28 oxen each working day. This consumption is considerably greater than that of the motor plough, which we calculated to be about 300 kilograms of starch.

Further advantages of the motor, besides this smaller consumption of energy, are that it ploughs the ground more thoroughly, so that it really does the work of from 36 to 40 oxen, and that only two men are required to work it, while the handling of 28 oxen would require at least seven. The advantages of oxen are that they can take more than half of their requirements in starch values in the form of hay, straw, beet chips, and other articles which cannot be used for human food, and that they provide dung, which is doubly valuable owing to the scarcity of manufactured manures in wartime. From the point of view of the national food supply the conclusion is that the motor plough should, where possible, be driven only with mineral fuels, but that failing these there is no great objection to the use of spirit. The motor plough is especially valuable where there is a scarcity of labour or of suitable draught animals, or where a deep ploughing of the ground is required; in fact it is to be preferred to oxen even if the undesirable use of spirit for driving it has to be made.

4. *Manures*

In order that our fields may continue to produce good crops, we must see that they are sufficiently manured.

Great attention should be paid to the care of stable dung, so that the plant fertilisers, particularly the valuable nitrogen contained in it, may not be needlessly lost. The importance of this has never yet been thoroughly appreciated. Various calculations show that stable dung loses about 30 per cent. of nitrogen while it is lying, which means a loss to Germany of at least 600 million marks. This is about five or six times the value of the imported saltpetre and almost equal to the sum spent on artificial manure by the whole of agricultural Germany.

To counteract these losses the application of various chemical preservatives has been recommended, but exact experiments have shown that these are not very efficacious when they are used on a sufficiently large scale. The loss of nitrogen is caused by the activities of various micro-organisms, most of which need oxygen, therefore in storing the dung suitably the air is allowed as little access as possible to the fermenting mass. The dung is stored tightly and damp, but the loss of nitrogen cannot be entirely prevented in this way. The nitrogen is better preserved in the stable pit, but even here the loss is still about 13 per cent. The best way of preserving it is by employing peat litter, which reduces the loss to 7 per cent.; wherever possible this means should be used. The separate storing of the solid and liquid parts of the dung according to the method of Soxhlet has a similarly favourable result. We draw the attention of the authorities to the fact that in many districts the sensible method of this Landrat has been of great benefit. A description of the process is given in the essay by Landrat Kaufmann, "Public Regulation of the Dung-heaps of a District," German Agricultural Press, 1903, No. 63. The example given should be widely imitated.

Of no less importance is the question of our supply of artificial manures. The enormous expansion of our agriculture is largely due to them.

We have been able to increase the yield of our fields per unit of area and at the same time to increase our whole harvest considerably. During the last thirty years our crops of grain and potatoes have been able to keep pace with the great growth of the population. The production of meat, which is of course in close connection with the production of sufficient fodder, has developed in a similarly favourable way.

It is important to understand clearly how these results have been brought about, so that we may be able to model future measures on them. Many factors have contributed to the success. Chief among these is the introduction and employment of artificial manures, which have caused the greatest change in farming and given the greatest impetus to it in the last century. Later came the great success in plant culture, the better working of the ground owing to the improvement in engineering, the fighting of plant diseases, etc. We have tried to estimate to what degree each factor has contributed to the increased harvests, and have come to the conclusion that the employment of artificial manures has contributed about 50 per cent., the cultivation of more prolific varieties 30 per cent., and other measures 20 per cent.

The great importance to our agriculture of artificial manures is thus obvious, and in the interests of our next harvests we must do all in our power to ensure that their use shall be diminished as little as possible, otherwise the consequences may be extremely serious to our agriculture and therefore to our food supply. An important question now arises: Can we produce in Germany itself the fertilisers which we need in order to keep up our harvest yield without the foreigner's help? And what can we do to avoid the danger caused by their absence?

Four materials are concerned—nitrogen, phosphoric acid, potash, and lime, and it is the production of the first three only which offers any difficulties. Of these nitrogen is by far the most important, as the following researches prove.

Wagner and his collaborators obtained the following average figures from their observations in ten different farms in the Grand Duchy of Hessen-Darmstadt:—

Harvest.	Without artificial manure.	Full manuring.	Full manuring without			Remarks.
			Potash.	Phosphoric acid.	Nitrogen	
	Double zentners per hectare.					
Oats	13·6	28·3	23·8	23·7	18·4	—

Hansen and his collaborators gained the following results on the experimental estate Dikopshof, Rhine Province (soft loamy soil):—

Harvest.	Without artificial manure.	Full manuring.	Full manuring without			Remarks.
			Potash.	Phosphoric acid.	Nitrogen	
	Double zentners per hectare.					
Sugar beet ...	372·7	500·5	455·3	481·3	364·7	Without dung
Sugar beet ...	452·6	531·5	524·4	519·9	475·0	with ,,
Wheat ...	21·36	32·17	31·79	32·57	22·88	without ,,
Wheat ...	27·30	36·66	35·39	36·59	27·02	with ,,
Rye	14·27	22·21	23·25	23·04	15·33	without ,,
Rye	19·20	25·83	27·18	27·05	21·09	with ,,

Schneidewind and his collaborators ascertained the following yields on an average of seven years (1903 to 1909) for various plants with different manuring at the experimental estate Lauchstedt in Saxony (soft, humous, loamy soil):—

Harvest.	Without artificial manure.	Full manuring.	Full manuring without			Remarks.
			Potash.	Phosphoric acid.	Nitrogen.	
	Double zentners per hectare.					
Sugar beet ...	320·8	416·2	406·3	372·2	339·2	without dung
Potatoes ...	141·0	221·1	158·4	186·6	198·7	—
Wheat ...	30·55	37·07	32·13	34·42	31·97	—
Barley ...	22·56	32·80	31·72	30·02	24·57	—
Sugar beet ...	398·2	436·3	434·5	422·7	402·6	with dung which was put on the previous sowing.
Potatoes ...	238·5	259·3	245·1	247·5	258·4	
Wheat ...	36·37	38·23	39·11	37·90	35·80	
Barley ...	28·36	33·35	33·33	32·15	29·51	

B. Schulze and his collaborators obtained the following figures from their experiments in eight different farms in Silesia:—

Harvest.	Without artificial manure.	Full manuring.	Full manuring without			Remarks.
			Potash.	Phosphoric acid.	Nitrogen.	
	Double zentners per hectare.					
			SANDY LOAM.			
Potatoes ...	254·2	287·2	281·7	289·0	256·0	With dung
Potatoes ...	144·1	230·5	179·8	207·9	154·4	without ,,
Rye	16·8	23·7	22·0	22·4	17·6	with ,,
Rye	15·2	20·3	19·7	20·4	14·7	without ,,
			VERY FERTILE CLAYEY SOIL, IN GOOD CULTIVATION.			
Potatoes ...	277·9	297·3	301·9	293·3	284·4	With dung
Potatoes ...	224·2	253·6	252·2	244·9	223·9	without ,,
Barley ...	28·30	31·25	31·27	30·27	29·10	with ,,
Barley ...	23·41	29·11	28·05	29·57	26·38	without ,,
			LIGHT SANDY SOIL, IN GOOD CULTIVATION.			
Potatoes ...	259·5	303·3	300·7	278·0	248·2	With dung
Potatoes ...	175·0	211·8	200·8	203·0	208·0	without ,,
Rye	13·94	15·54	13·10	14·85	15·08	with ,,
Rye	12·60	14·46	13·80	13·47	14·46	without ,,
			LIGHT SANDY LOAM.			
Potatoes ...	220·5	260·8	251·5	235·8	213·8	With dung
Potatoes ...	91·8	141·0	115·8	112·5	124·7	without ,,
Rye	11·47	13·87	12·18	13·67	11·83	with ,,
Rye	6·86	13·74	11·28	7·50	8·85	without ,,
			HEAVY CLAY SOIL.			
Potatoes ...	223·1	251·6	215·7	226·6	235·7	With dung
Potatoes ...	166·5	197·0	151·8	170·4	178·4	without ,,
Barley ...	18·32	21·36	19·85	21·82	19·66	with ,,
Barley ...	15·84	22·53	17·80	20·70	18·53	without ,,
			HEAVY SOIL.			
Potatoes ...	229·6	260·7	257·9	256·9	258·5	With dung
Potatoes ...	159·2	202·0	179·0	205·0	196·5	without ,,
Oats... ...	25·05	24·73	26·47	25·18	26·4	with ,,
Oats	21·82	25·85	24·99	25·72	23·50	without ,,
			DEEP CLAY SOIL.			
Beet	364·50	430·70	423·00	414·13	383·78	With dung
Beet	243·39	379·36	365·74	347·10	322·21	without ,,
Barley ...	25·03	28·70	26·32	28·44	25·39	with ,,
Barley ...	18·41	27·84	25·51	25·59	18·03	without ,,
			MODERATE LOAM.			
Potatoes ...	277·86	288·06	286·57	272·48	286·20	With dung
Potatoes ...	160·07	205·86	191·88	207·21	173·70	without ,,
Wheat ...	26·21	27·00	26·97	25·58	24·65	with ,,
Wheat ...	19·44	28·19	24·84	25·86	22·02	without ,,

Tacke and his collaborators gained the following harvests on soils of different constitutions in the province of Hanover :—

Harvest.	Without manure.	Full manuring.	Full manuring without			Remarks.
			Potash.	Phosphoric acid.	Nitrogen.	
	Double zentners per hectare.					
Beet	157·8	493·6	474·4	403·8	492·6	Heavy soil (17)
Wheat ...	11·6	23·0	22·4	22·2	18·3	—
Oats	13·5	26·3	22·4	23·7	15·8	Heavy soil (6)
Oats	18·6	28·6	28·6	27·6	19·9	Moderate soil (35)
Oats	20·7	35·7	35·5	28·2	29·2	,, ,, (11)
Oats	31·3	37·7	32·4	36·4	33·8	,, ,, (47)
Potatoes ...	137·3	196·3	182·0	185·5	136·2	Light soil (1)
Rye	7·0	15·7	16·6	15·5	7·5	—
Rye	17·3	29·8	29·3	29·7	15·6	Light soil (10)
Rye	14·5	29·4	23·1	24·6	15·0	—
Potatoes ...	105·3	185·6	125·6	156·3	121·9	—
Rye	1·3	17·5	10·3	14·2	5·9	— (57)
Oats	2·7	14·3	12·0	12·0	8·0	—
Rye	1·2	17·5	13·6	13·1	6·0	—

Lemmermann and his collaborators made the following observations on the experimental fields at Dahlem, Brandenburg (moderate soil) :—

Harvest.	Without artificial manure.	Full manuring.	Full manuring without			Remarks.
			Potash.	Phosphoric acid.	Nitrogen.	
	Double zentners per hectare.					
Summer wheat	25·4	31·65	30·4	30·99	27·98	1910 without dung
Winter wheat	29·56	36·14	36·13	37·28	30·63	1911 ,, ,,
Fodder beet ...	93·12	165·71	173·33	176·12	137·63	,, ,, ,,
Summer barley	36·39	49·01	44·48	47·29	38·05	1912 ,, ,,
Potatoes ...	177·36	252·68	216·49	245·52	214·81	,, ,, ,,
Potatoes ...	165·84	262·57	250·29	268·28	259·58	1913 ,, ,,
Summer wheat	27·35	30·45	31·78	32·66	30·60	1910 with dung
Potatoes ...	71·48	103·52	100·31	103·45	71·50	,, ,, ,,
Winter wheat	31·41	38·31	37·09	37·55	31·69	1911 ,, ,,
Fodder beet ...	171·78	197·85	172·93	191·80	176·31	,, ,, ,,
Summer barley	35·73	49·11	42·79	47·22	38·48	1912 ,, ,,
Potatoes ...	190·54	243·34	238·26	259·32	220·24	,, ,, ,,

In their researches in different districts in the province of Brandenburg, Lemmermann and his collaborators found the following yields on lighter soil:—

Harvest.	Without manure.	Full manuring.	Full manuring without			Remarks.
			Potash.	Phosphoric acid.	Nitrogen.	
	Double zentners per hectare.					
Winter rye ...	23·59	28·39	23·60	25·04	23·60	Perleberg, 1913
Winter rye ...	12·07	17·56	16·72	14·85	10·15	Schwiebus ,,
Winter rye ...	20·95	29·65	26·35	25·10	20·06	Seelow ,,
Potatoes ...	307·5	351·8	340·1	334·7	318·6	Friedeberg ,,
Potatoes ...	123·5	195·2	179·2	196·5	119·6	Wittstock ,,
Potatoes ...	152·12	185·08	182·45	176·25	166·48	Zielenzig ,,

These researches prove that nitrogen, in comparison with potash and phosphoric acid, plays such a great part that on most soils it determines the amount of the harvest.

Of these four fertilisers there is a sufficient quantity both of lime and of potash available in Germany, so that their provision need not cause us the least anxiety.

But in spite of this there is a danger that insufficient manuring with potash will take place. The traffic conditions make it difficult for the railways to deliver the necessary quantities of artificial manures to the farmers in time. The conferences which have taken place on this matter, however, lead us to hope that the railways will in the long run be able to overcome the difficulties in regard to obtaining trucks, etc.

It is to be feared that owing to the present difficult circumstances the farmers will be shy of buying manure to any great extent, but this would be to conjure up the danger of a barren harvest next year. The restriction of potash manuring would be particularly hazardous in the case of our wide stretches of lighter soil.

As the freight charges to the more distant parts of the country are not infrequently higher than the actual price of the potash, the State could materially help to avoid this danger by lowering or perhaps by suitably grading the freight charges; in this way it might even encourage the smaller and poorer farms to make an increased use of potash. What the State thus relinquished in freight charges it would more than regain in the freight charges for the greater harvest yields. The loss in primary freights for the raw material potash which increases the production would be easily balanced by the increased secondary freights for the augmented production. It is, of course, not these fiscal considerations which decide the matter; but apart from them the State must so adjust the freights for potash that a decrease in potash manuring may be counteracted as far as possible, because such a decrease would endanger the next harvests.

The case of phosphoric acid is different from that of potash and lime. The requirements of our fields in this case are supplied chiefly from two sources. On the one hand, the great quantities of basic slag from the blast furnaces contain phosphoric acid, which is made available for plants by grinding the slag fine. On the other, we obtain superphosphate by treating raw phosphate with sulphuric acid.

We have hitherto met our requirements in phosphoric acid largely by the help of the foreigner. The basic slag has, of course, been produced in the country, but we imported great quantities of phosphoric iron ore for its preparation. In 1910 we produced 2,110,000 tons of basic slag and used 1,900,000 tons of it ourselves. For its preparation we used about 23 million tons of native ore and about 10 million tons of foreign ore, including

7·2 million tons from Spain and other countries from which we are at present cut off, 3·8 million tons of this coming from Sweden.

We may assume that the Swedish import of phosphoric ore will continue during the war; the Luxemburg stocks will also provide us with such ores, and in any case we have our own large stocks in Lorraine at our disposal.

Under these conditions our production of basic slag depends solely and only on the extent of our iron production, which will not suffer particularly from the loss of export trade in view of its close connection with the needs of our army.

Our production of superphosphate is more affected by the war. Both the necessary raw materials have hitherto been obtained directly or indirectly from abroad. In 1913 the greater quantity of the raw phosphates came from the United States (421,000 tons), also 299,000 tons from Algiers and Tunis, 130,000 tons from the South Seas, and 53,000 tons from Belgium, a total of about 930,000 tons. The imported 930,000 tons of raw phosphates did not all remain in the country, for we re-exported about one-seventh of them in the form of superphosphates, so that only about 792,000 tons were used.

The second raw material required in the preparation of superphosphate, sulphuric acid, is almost without exception produced in this country, but mainly from foreign materials. Altogether about 1,650,000 tons of sulphuric acid were produced in Germany in 1912, and there was also a nett import of 23,000 tons, so that the consumption amounted to about 1,673,000 tons. In order to convert one ton of raw phosphate of the moderate composition used in Germany (70 per cent. calcium triphosphate) into superphosphate, 0·44 ton of sulphuric acid is required. The 792,000 tons of raw phosphate used in Germany therefore required 350,000 tons of sulphuric acid, and this part of our production of sulphuric acid was employed in the preparation of superphosphate.

Sulphuric acid is mainly produced from pyrites and zinc blende. Pyrites gives 138 per cent. of its weight in sulphuric acid, zinc blende only 61 per cent. In 1913 we obtained 138,000 tons of sulphuric acid from 100,000 tons of our own pyrites and 250,000 tons from 410,000 tons of our own zinc blende, so that 388,000 tons of sulphuric acid were produced from our own raw materials, that is, rather more than we need for the preparation of superphosphate. We must, however, remember that we need sulphuric acid in Germany for other no less important objects, and therefore we are still to a certain extent dependent on the foreigner for the second raw material required in the preparation of superphosphate, namely, sulphuric acid.

We cannot reduce our deficit in raw phosphates to any appreciable extent with the few stocks in Germany, *e.g.*, in the Lahn valley, but the raw phosphate stores in Belgium call for serious attention; one is in the province of Liège and the other in Hennegau. If the sulphuric acid prepared from our own zinc blende and pyrites is not sufficient for treating the available raw phosphate, we may be able to fall back on the sulphide ore stocks at Rammelsberg, near Goslar. The ores obtained there give about 60 per cent. of their weight in sulphuric acid and are therefore almost as useful for its production as zinc blende. We should, however, still be able to treat the raw phosphates electrolytically with the help of perchlorates according to Palmaer's process.

In spite of all this our agriculture has still to reckon with a certain lack of phosphoric acid less in the form of basic slag than in the form of superphosphate. The fact that we may have to restrict somewhat the manuring of our fields with phosphoric acid will not have any appreciable effect on the harvests of the next few years, because the fields which need such manuring are more or less enriched with the surplus phosphoric acid of the last few years.

The procuring of nitrogen is incomparably more important to us. As has been shown (pp. 119–122), good harvests depend more on its sufficient use than on the use of any of the other manures. This may be seen from the following figures. It has been calculated that about 8,000,000 double zentners of nitrogen salts are missing from the amount of our previous consumption, and further that every double zentner of nitrogen for the cornfields which is missing in March and April will diminish the yield by 3½ to 4 double zentners of grain. The loss of 8,000,000 double zentners of nitrogenous salts would therefore mean a loss of from 28 to 32 million double zentners of grain, *i.e.*, about a fifth of our wheat and rye harvest.

Nitrogen is put on our fields in several forms—stable dung, vegetable manure, and the various artificial nitrogenous manures. Among these by far the most extensively used is Chili saltpetre. In 1913 we imported 750,000 tons of it and used about 525,000 tons as manure, which contained 78,750 tons of nitrogen. In its chemical constitution and effect Chili saltpetre is most closely resembled by the nitrate of calcium obtained from the nitrogen of the air by means of the electric arc, of which we import small but annually growing quantities (in 1913, 38,000 tons) mainly from Norway (Norwegian saltpetre). Next to saltpetre, the most important nitrogenous manure is sulphate of ammonia, which is obtained in large quantities in the distillation of coal (coke manufacture) and lately also direct from its elements (nitrogen and hydrogen) by catalysis, according to a process worked out by Haber and already used on a large scale. In 1913, the amount of nitrogen used for manuring in the form of sulphate of ammonia (94,700 tons) was 16,000 tons more than that used in the form of Chili saltpetre. The fourth kind of artificial nitrogenous manure is nitrolin (calcium cyanamide) which is obtained from calcium carbide by the addition of nitrogen, and with a smaller expenditure of electric energy than is required for Norwegian saltpetre. When we have learned how to overcome the difficulties in the way of its use as a manure, the preparation of nitrolin should have a great future in Germany.

Chili saltpetre provided nearly half the nitrogen we used for artificial manure, and as this is now missing we must look round for a substitute. Suitable storing of stable dung (p. 117)) and a suitable use of vegetable manure can help considerably, but we must still try to obtain more artificial nitrogenous manures.

In view of the difficulties caused to the coke trade by the diminution in the iron industry, we must be content if our production of sulphate of ammonia remains at the same amount as last year. We can help by using as much coke as possible in place of coal and other fuels, because in this way we shall assist the production of benzoline for the agricultural motors (p. 113), and at the same time the preparation of nitrogenous manures. In addition Haber's and similar modern processes should be increasingly employed. More nitrolin could be obtained. If full use were made for the preparation of calcium carbide, of the large amount of electrical energy which is available in the Overland Central and other electric power stations in Germany, enough nitrolin could be produced to replace the whole of the Chili saltpetre.

Chili saltpetre contains 15 per cent. of nitrogen, so that 112,000 tons of nitrogen are contained in the 750,000 tons imported. As nitrolin contains 20 per cent. of nitrogen, we should have to produce 560,000 tons of nitrolin in order to obtain 112,000 tons of nitrogen. By means of calcium carbide one horse-power is able to furnish about two tons of nitrolin a year, so that 280,000 horse-power would be required to give us in the form of nitrolin full compensation for the missing Chili saltpetre. The great electric stations in Germany generated in 1913 about two million horse-power, and were on an average loaded with only 18·8 per cent. of their highest capacity. Here then is a very considerable amount of energy available, and it is also technically possible, without disturbing the other operations of the electricity works, to apply it to the production of the nitrolin which is so important to our agriculture.

Nitrogenous manures are so important to our national food supply that no delay in procuring them is permissible. It would not be desirable to leave their production to private industries alone, for they would hardly be able to cope with it unaided. The significance of this question for the whole nation demands rather that the State should take into its own hands the business of providing Germany with sufficient nitrogenous manure, and if necessary adopt measures for its production.

5. *Moorland Cultivation. Inland Colonisation*

Besides endeavouring to obtain the best seed, good tillage and sufficient manures, we should give serious consideration to the possibility of making available for farming and cattle-rearing land which has hitherto been used imperfectly or not at all. According to Fleischer there are in Germany about 20,000 square kilometres of still unused moorland which sufficiently exact experiments have proved could easily be made of high agricultural value, and there is at least an equally wide area well worth cultivating, which largely resembles the moorland in character (marshy land, heath).

Experience in the last few years has shown that with suitable tillage, draining, and addition of the requisite mineral manures, crops can be obtained from moorland and heaths which are at least equal to those from the best arable and meadow lands, sometimes even better. Moorlands and sandy ground which are poor in lime and nitrogen need the application of all the fertilisers which we have been considering (lime, potash, phosphoric acid, and nitrogen), while the low-lying moorlands which are naturally rich in lime and nitrogen generally need manuring only with potash and phosphoric acid. In view of the expected scarcity of nitrogenous manures, it is of especial importance that at least part of our great stretches of uncultivated lowlands, estimated at about 10,000 square kilometres, can for the present be made serviceable for grain and root cultivation without the help of nitrogen, even though later they are used for their normal purpose of fodder growing (meadows and pastures). This temporary use as arable land in most cases permits of a later change to pasture and meadow land. Hitherto the cultivation of moorland has made slow progress, partly because the legal and administrative difficulties arising out of the ramifications of ownership, and the extremely complicated water conditions, were not easy to overcome, and partly because credit and labour for improvements were lacking.

How much the moorlands with liberal cultivation can contribute to increasing our food supply may be seen from the experiments which Tacke and others have carried out in different places during the last few years. It was suggested by these experiments, and has been confirmed later by large practical enterprises, that the surfaces prepared for pasturage as well as the moorland meadows furnish as much and more fodder for fattening purposes or as much hay as the same area of the best marsh land. The experiments further show that the newly improved moorland can furnish very abundant grain harvests and that potatoes also yield good crops on such land. At the present moment we have in the prisoners of war an exceptionally valuable supply of labour for the improvement of large stretches of moor land. The Russian prisoners are mostly agricultural labourers and could be used at once for such work. In Rhyn-Luch and northern Hanover this has already been begun. In order to carry out these improvements on a scale commensurate with the amount of labour available and in order that the land may where possible be ready in time for the next spring sowing, the combining of large private moors must be hastened by suitable legislative and administrative measures or the owners must be dispossessed by the State on the understanding that equitable compensation will be settled later, and the provision of cheap money for the improvements must be attended to. When we think that one hectare of good improved moorland yields a certain harvest of about 20 to 30 double zentners of rye and oats or from 180 to 220 double zentners of potatoes, or if used as meadow land an average of 50 to 60 double zentners of valuable hay, or if used as pasturage three to four double zentners increase in live weight, we realise that no small portion of our severed imports could be replaced in this way. This project would at the same time help to make our food supply permanently independent of the foreigner.

Besides the uniform improvement of large areas of moorland the intensive farming of small tracts for horticultural purposes must be considered. The latest researches of the Moorland Experimental Station show that on high moors and on heath land nearly all green vegetables can be cultivated in this way with the greatest success, and this discovery is endorsed by the intensive culture of green vegetables which has been carried on for some time in the lowlands of Northern Holland. Prisoners of war and unemployed workmen are specially suitable for this culture, as it is generally only necessary to trench the ground deeply all over with the spade, and any unskilled labourer can do this. In this way very large crops could be obtained on a small space.

The moorlands and heaths on both sides of the Hamburg-Bremen railway are particularly suited to this method of increasing our food supply, especially in view of the possibility of easy conveyance, so important to horticulture. The work could be materially aided if the men liable for service in the Landsturm were employed as overseers, for they have had some experience on the land and could therefore act to a certain extent as foremen.

Another, although a small, increase in our harvest yield would be possible by extending the irrigation works in the neighbourhood of large towns. Most of these works, of course, have the disadvantage that a great amount of their small area is taken up by the fertilising overflow waters. If we could now make use of the present cheap labour to extend these works over larger areas, the irrigation could be more fully utilised and the whole yield considerably increased.

Finally, a rise in our agricultural production could be attained by dividing up the larger estates into small holdings. In smaller and medium sized peasant holdings the production of crops and the rearing of cattle can be more thoroughly carried out. In the present situation where everything depends on a large yield from our agriculture, even the opponents of inland colonisation should be converted. Now, when the war has carried off many owners of large estates or made them unfit for work, and when the danger that many estates will be bought up by dealers is threatening, especially in eastern Germany, the State must promote inland colonisation with special ardour.

CHAPTER VIII

KEEPING ANIMALS

1. *Reduction of the Stock of Pigs and Milch Cows*

One thing we must do under any circumstances—reduce our live stock.

We have lost a large amount of foreign fodder, particularly barley, maize, bran, and oil cakes. Hitherto we have used this fodder partly for pig fattening and partly to increase the yield of milk from our cows beyond what would be possible with home-grown fodder. We should make our deficit larger if, instead of this fodder, we used materials suitable for human consumption, such as grain, for in doing this more than half the nutriment is always lost.

Besides this we shall be obliged to deprive the cattle of part of their fodder which can be used for human food. The Imperial Government has forbidden under pain of prosecution the use of bread corn as fodder; two million tons of rye were so used annually. This will cause a considerable reduction of the deficit in human food, because the animal foodstuffs produced with the help of the grain have not half its nutritional value.

In future we must divide the fodder available among a smaller number of animals, for it is on the whole more advantageous to feed a small number of animals plentifully than a larger number sparingly. The mere reduction in number of animals among which the given amount is to be divided makes it possible to produce more human food with the same expenditure of fodder and thus lessen still further our deficit.

The required reduction of our live stock necessitates slaughtering some of the animals and limiting breeding and rearing. We can understand that the thought of such a reduction in his fine stock of animals obtained after long and painstaking industry will make many a farmer's heart bleed, but sentiment must be put aside when we have to do what the present war demands for our existence. Reducing our live stock can only be justified if we keep sufficient to utilise fully our agricultural raw products and do not harm the agricultural business of stock-rearing to the detriment of agriculture generally. It is important that on the return of peace our thoroughbred strains should be available again to an extent worthy of their great value.

Important practical questions arise in connection with reducing our live stock which are not easy to answer. The first is with which kind of animal the reduction shall begin.

Two points of view have to be considered. The first concerns the sort of fodder which the various kinds of animal eat. Stock which live principally on food man cannot digest, *e.g.*, cattle which are fed on hay and straw, and sheep which for the greater part of the year maintain themselves on pastures of little value, increase our food supply by changing these inedible materials into milk and meat, but stock principally fed with materials also fit for human consumption lessen our food supply because not half of what these animals eat returns to us in the form of animal foodstuffs.

In reducing our live stock, therefore, we should only remove those animals which deprive us of foodstuffs (or, more exactly, cause a loss of nutriment by changing them into something pleasing to us) and not those which provide foodstuffs by eating materials which are not directly useful to man. Thus a reduction of the stock of pigs must first be considered, for the pig is man's greatest competitor in food.

The second point of view concerns the utilisation of fodder. We should remove those animals which make a bad use of the fodder supplied them before those which make a better use of it. In this connection the different yield of meat and milk production is of special interest. The following calculation is based on researches and estimates by Kellner on the analyses of animals for slaughtering and of cows' milk compiled by König.

A pig of two months weighing 15 kilograms needs, in order to fatten it to 120 kilograms in nine months, 45 kilograms of digestible protein and altogether 1,372,000 calories. When killed it provides 13·1 kilograms of protein and 64 kilograms of fat. At its first weight of 15 kilograms it contained 2·1 kilograms of protein and 3·5 kilograms of fat, so that it produces 11·0 kilograms of protein and 60·5 kilograms of fat. These nutrients represent 11 × 4,100 = 45,100 calories + 60·5 × 9,300 = 562,650 calories, together 607,750 calories. Comparing this yield with the 45 kilograms of protein and 1,372,000 calories used for fattening, we find that 24·4 per cent. of the protein and 44·3 per cent. of the calories are regained for human food.

The utilisation of fodder is quite different in the case of fat oxen. A calf weighing 50 kilograms is made to weigh 360 kilograms in sixteen months by consuming

246 kilograms of digestible protein and 5,031,000 calories. When killed it provides 57·6 kilograms of protein and 61·2 kilograms of fat; in its first weight of 50 kilograms were contained 8·0 kilograms of protein and 7·0 kilograms of fat, so that it produces 49·6 kilograms of protein and 54·2 kilograms of fat, corresponding to 707,420 calories. From the nutriment contained in the fodder therefore 20·3 per cent. of the protein and 14·1 per cent. of the calories are regained in meat and fat.

A milch cow weighing 500 kilograms which gives 2,200 litres of milk a year, with an average daily production of 7·5 kilograms of milk, must be milked on 293 days and stand dry on 72 days. To produce 7·5 kilograms of milk she needs 0·65 kilograms of digestible protein and 18,040 calories every day, that is, 190·5 kilograms of protein and 5,286,000 calories in 293 days. To this must be added fodder containing 0·3 kilogram of protein and 10,660 calories for 72 days, altogether 21·6 kilograms of protein and 767,500 calories. The total yearly requirement therefore amounts to 212·1 kilograms of digestible protein and 6,053,500 calories. The 2,200 litres of milk contain in each litre 35 grams of protein and 650 calories, that is, altogether 77 kilograms of protein and 1,430,000 calories. 36·3 per cent. of the protein and 23·6 per cent. of the calories given in fodder were therefore regained in the milk.

The different amounts of nutrient values required for production are shown in the price of milk and meat. Putting 1 litre of milk at 20 pfennigs and 1 kilogram of pork at 2 marks, a quantum of milk containing 100 grams of protein costs 57 pfennigs and a quantum of pork containing the same amount of protein costs about 1 mark. As, apart from protein, milk contains much more nutriment than meat, the same amount of nutriment costs considerably less in milk than in meat.

In the utilisation of protein therefore the milch cow is greatly superior to the pig and to fat oxen. On the other hand, the pig stores a greater proportion of the calorie contents of the food in its fat than the cow does in her milk. As at the present time we must look especially for good utilisation of existing protein, we should keep the milch cows as far as possible and only reject those which are bad fodder utilisers.

If it were only a question of fodder utilisation we should reduce the fat oxen first, but as the kind of fodder required is more important the reduction of the live stock must begin with the pigs.

2. *Extent of Reduction of Live Stock*

The second question is, To what extent must our stock be reduced?

Two reasons compel the reduction: the lack of foreign fodder and the prohibition to use, as has hitherto been done, corn (especially rye) for feeding animals. Both these must lead to a considerable reduction in our live stock, for there would be no object in keeping the present number on insufficient and therefore unproductive food.

There are two ways in which we can more or less fix the requisite reduction numerically. In the first place we can take the imported fodder and the home-grown corn used as fodder as our point of departure and ask how many animals we must get rid of when these are lost, and in the second place we can begin with the fodder still at our disposal and ask how many animals we can maintain with it; either way will give the number to be removed. It is best to begin with what is missing in order to obtain a result for the whole of Germany, because the missing amount of fodder can be ascertained for the whole Empire with much greater exactness than the amount still available. On the other hand, we must begin with what is still available when we have to decide in the case of a particular district or a particular farm to what extent it should take part in the universal reduction of live stock, and whether it should remain below the general fixed percentage or exceed it, for only in this way can special conditions be taken into account.

We will now consider on what scale we must reduce our live stock as a whole. The fodder now missing was chiefly used for two objects—pig-fattening and the feeding of milch cows. The imported barley and maize were principally used for pig-fattening, and all the other imported fodders and the rye principally for the production of milk. It would be wrong to assume that this occurred in either case without exception, but the deviations from the rule will more or less balance each other, so that we shall not make any great mistake if we reckon the barley and maize as having been used only for pigs and the other fodders only for cows.

According to this way of reckoning, we used our nett imports of barley and maize for pig fattening so far as they were used for fodder. On an average for the years 1912 and 1913 this was altogether 2,925,602 tons (p. 61) containing about 240,000 tons of protein. These fodders are missing. To ascertain how many pigs they enabled us to feed we must not simply consider the physiological fact that a pig of nine months requires on an average in order to fatten it from 15 kilograms to 120 kilograms of fodder containing 1,372,000 calories (p.135), which according to the calorie value of barley and maize would mean an expenditure of 493 kilograms of barley and 411 kilograms of maize. This estimate of requirements does not take into account the great losses which occur in carriage and storage of fodder, in the feeding itself, and through indigestion and illness of the beasts, nor the animals which die of disease. We should therefore do better to reckon, like the practical farmer, that a pig increases 1 kilogram in weight with about 5 kilograms of grain (about 5½ kilograms of barley and correspondingly less maize). Expressing the nourishment required to fatten a pig from 15 to 120 kilograms in terms of grain, we find that on an average 525 kilograms of grain would be required (about 575 kilograms of barley). With the 2,925,602 tons of foreign fodder we should therefore have fattened (2,925,602,000 divided by 525) about 5½ million pigs. That is rather more than one-fifth of the 25½ million pigs counted at the last census of live stock,

Fattening with barley and maize is not common in actual farms, but is mainly used in the great fattening establishments, which are more like manufactories and are found especially in the province of Hanover. As we are not able to replace foreign grain with home-grown grain, we must reduce our pig fattening correspondingly, and it is these great fattening businesses which will be most affected by the reduction.

According to the method of reckoning which we have chosen for the sake of simplicity, we used for the production of milk the now missing foreign fodders (with the exception of barley and maize) and the home-grown rye fodder. The nett annual import of these fodders amounted on an average for the years 1912 and 1913 to 4,377,000 tons, containing 664,000 tons of protein (p. 70). We may estimate the home-grown rye fodder at 2,000,000 tons, containing 192,000 tons of protein; in place of this, we can now only use about 400,000 tons of bran from the rye, containing 50,000 tons of protein, so that we have lost 142,000 tons of protein. Thus altogether 806,000 tons of protein are lacking for the production of milk.

The protein content of this fodder contributes largely to the formation of milk; this fact is of crucial importance in answering the question how many milch cows did it enable us to keep. A cow gives an average yearly yield of 2,200 litres of milk. To ascertain the number of cows maintained with the missing fodder we must know how much protein a cow consumes in fodder on an average in order to give this milk.

We must not base our calculations on the ascertained physiological protein requirement of 212 kilograms of digestible protein (p. 136) for a cow which gives 2,200 litres of milk, because the actual protein consumption regularly exceeds the requirement in view of the losses in carriage and storage of the fodder, indigestion, illness, etc. This extra consumption is sure to have been particularly great in those farms which feed abundantly and use foreign fodder.

To determine the actual protein consumption in such farms we can base our calculations on the agricultural fodder-supply rules. According to these a milch cow needs in the first place for sustenance an average of 350 grams of protein daily, in a year 365 times as much, *i.e.*, 128 kilograms; and, secondly, for milk making, according to Kellner's (perhaps somewhat higher) statement, about 70 grams for each litre of milk, *i.e.*, for an average yearly yield of 2,200 litres of milk, 2,200 times 70 grams, that is, 154 kilograms. Altogether this means an average yearly protein consumption for each cow of 128 + 154 = 282 kilograms; the usual composition of the fodder meets the calorie requirement, so that we can ignore this.

With the 806,000 tons of protein in the form of imported fodder and the home-grown rye no longer available for fodder, we should therefore have been able to feed 2·86 million more milch cows than would have been possible without these fodders. As the number of our milch cows according to the last census was about 10½ millions, this is 27 per cent. of our milch cows. In view of the missing foreign fodder and the prohibition to use home-grown rye as fodder, we must therefore (if there is no other way out of the difficulty) get rid of nearly 3 million cows, rather more than a fourth of our stock.

This assertion must not be understood to mean that 3 million cows were fed only from fodder which is no longer available (foreign fodder and home-grown rye) and must therefore be removed. Naturally this was not the case. Besides these fodders many other kinds of fodder which are still available were given; native strong fodder and sap fodder, as well as hay and straw for padding, but this does not alter the result of the calculation. Assuming (and it probably corresponds more or less to the facts) that the foreign fodder and the rye were used to meet two-thirds of the protein requirements of 4½ million cows, the absence of these fodders would mean that 3 million cows must be removed in order that the fodder still available may be divided among the remaining 1½ million cows, and so enable them to keep up an undiminished yield of milk.

This calculation, however, only gives a temporary picture. It contains the quite incorrect supposition that (apart from the reduction in the number of cows) farming will be carried on in the same way as hitherto. This must not be done; we have to obtain and to save fodder. The farmer must now use all the means which he uses in years when fodder prices are high to maintain his stock of cattle in the way indicated by businesslike management.

The substitution of human foodstuffs for absolute fodder must be eliminated, and every means must be employed to increase the available fodder and make a fuller use of it. Suitable plants must be cultivated; fodder must be treated with care; bad fodder utilisers must be removed; economy must be practised in feeding, so that the very common waste of rough fodder may cease and each animal be fed according to the amount of work it does. This would make a considerable correction in our first calculation. It would, however, be wiser not to concern ourselves with the new fodder to be obtained, but only with that which has to be saved.

These plentifully fed cows must have received about 282 kilograms of protein as calculated by Kellner instead of the physiologically necessary 212 kilograms in order to produce 2,200 litres of milk annually, though their average yield may, of course, have been higher. We may assume on the following grounds that they amounted to 3·5 millions. In the farms which feed plentifully from foreign fodder, the protein contained in it supplies two-thirds of the protein consumed by the cows.

Reckoning the annual consumption at 282 kilograms, each cow would receive 188 kilograms from foreign fodder. The 664,000 tons of protein imported in the form of fodder would therefore have been used for 3·5 million cows.

In the case of these plentifully fed cows it would not be possible to save the 70 kilograms of protein which they received in addition to their physiological requirements, because a certain loss of fodder is unavoidable in the carriage and storage and in feeding owing to indigestion, illness, etc.

Reckoning the avoidable and unavoidable losses as equal, the necessary consumption for each cow in order to produce 2,200 litres of milk a year is 247 kilograms of protein, so that on each cow 35 kilograms of protein could be saved, and altogether $3\frac{1}{2}$ million × 35 kilograms = 123,000 tons of protein.

In the case of the 7 million cows which did not receive the greater part of their protein in the form of foreign fodder there was no less loss of fodder through keeping bad fodder utilisers, not using up the fodder or letting it decay, and so on; we should certainly not estimate this loss too high if we set it at 20 per cent. of the protein contained in the fodder, so that each cow received 265 kilograms of protein, rather more than less.

Putting the necessary consumption of these cows in order to produce 2,200 litres of milk a year at 247 kilograms of protein, we find that of the extra consumption beyond the physiological requirement of 212 kilograms about two-thirds was unavoidable and only one-third avoidable. As many of our native fodders are much more perishable, it is at once evident that the unavoidable loss must generally be greater in their case than in the case of foreign fodder. At the same time, 18 kilograms of protein could be saved annually in the case of each of these 7 million less plentifully fed cows, or 7 million × 18 kilograms = 126,000 tons of protein altogether.

We may therefore without incaution regard it as possible to save 123,000 + 126,000 = 249,000 tons of protein. Allowing a necessary consumption of 247 kilograms of protein for each cow which gives 2,200 litres of milk in a year, this saving would mean that about another million cows giving this yield of milk would not have to be removed.

There is another possible way of obtaining fodder for the numerous cows to be kept, and that is by reducing the pigs. As we have seen, considerably more protein for human nourishment is obtained from the protein contained in the fodder in the case of milk than in the case of pork. In the production of milk, the protein in the fodder is better utilised by nearly 50 per cent. Our scarcity of protein therefore compels us to limit the production of pork rather than the production of milk.

To find how many pigs must be got rid of in order to provide fodder for one cow we must begin with the necessary nutriment consumption of both kinds of animal, adding the physiological requirement to the unavoidable loss caused by illness or indigestion or decay of fodder. In the nine months in which a pig is fattened from 15 kilograms to 120 kilograms, it needs, including the unavoidable losses, an average of 575 kilograms of barley (p. 139) containing about 50 kilograms of protein and 1,600,000 calories. A cow which gives 2,200 litres of milk a year needs, again including the unavoidable losses, in nine months three-quarters of 247 = 185 kilograms of protein and (assuming that the unavoidable loss in calories is as great as the loss in protein, so that the yearly consumption would be 7,060,000 calories and not 6,053,000), three-quarters of 7,060,000 = 5,300,000 calories. Therefore for every 3½ pigs which we cease to feed we could keep one cow.

By raising the number of pigs by which we must reduce our stock (5½ million) to 9 million, we could with the fodder so gained save another million cows from the general reduction, and the number of cows to be got rid of then sinks to one million. If we raised the number of pigs which we ceased to feed to 12½ million, we should be able to keep the whole of our stock of milch cows.

This, however, would not be desirable. A certain limitation of milch cow keeping is indispensable in order to remove the bad fodder utilisers and thus to attain a more complete use of our fodder.

A too great limitation of pig-keeping would be unwise in view of the very great change in our diet which it would cause. Therefore it is necessary to choose a middle way. Such a way would be to reduce our stock of milch cows by one million and our stock of pigs by 9 million. As about 10½ million milch cows and 25½ million pigs have been counted in Germany, this means that our milch cows (with the same average yield of milk) are to be reduced by 10 per cent. and our pigs by 35 per cent.

3. *Carrying out the Reduction of Live Stock*

It must not be thought that the desired reduction of the stock of milch cows and pigs could be carried out systematically throughout the whole of Germany. To what extent the general rule is to be followed depends on the fodder available in each district or even on each farm; sometimes we should not make a reduction of the stock on the scale settled for Germany generally, perhaps all the animals might be kept, and sometimes we should exceed the percentage.

If the number of animals to be kept and the distribution of fodder could be decided from one centre, it would be easy to settle individual cases in such a way that the requisite reduction of stock would be made, but this is not possible, so there will be a difficulty in inducing the greater number of farmers to act in the interests of everybody, especially as many agricultural enterprises are now robbed of their expert managers. The State and local authorities, by buying and storing meat, must bring about the necessary reduction of live stock, prevent a sudden drop in the price of meat, and secure provisions for the future. At the same time, the farmer must be instructed so that he may know what kind of animals he shall remove and how he shall feed the remainder.

The first question is, How are we to carry out the reduction of our stock of 10·5 million milch cows by about 10 per cent.?

Experience shows that the utilisation of fodder for the production of milk varies greatly with different cows. According to the development of the milk gland, a varying percentage of the food taken is changed into milk. With every animal, part of the fodder is used for sustenance and only the remainder for the production of milk. Assuming that the food requirement for sustenance is the same for all cows, we can easily see that the animals with the most productive milk-glands make the most advantageous use of their total rations. What can be more obvious therefore than to recommend that all fodder-wasters and all cows which give a small amount of milk should be done away with? If they were all removed there would be sufficient food left for the sustenance and use of the good fodder utilisers.

Such a general recommendation would, however, be partly unwise and partly impracticable. A difficulty arises at once in the question, What is a bad milker? At what degree of productiveness shall the dividing line be drawn between the animals to be kept and those to be killed? Looking at the actual circumstances, we see that in the various countries of Germany very varying types of cows are kept, and that though all these types are used for milk production they show great differences in size, age of maturity, and productiveness. Even in time of peace it is the farmer's aim to make the best possible use of fodder; but it is neither a mistake nor a drawback to keep the less good milkers. We know that in most cases the principal problem of cattle rearing is how to make the best use of the fodder obtained on the spot, and that the object of buying additional fodder is to make suitable rations from it and the local fodder together. In view of the influence of the soil on cattle keeping, great harm would be done if we simply reduced our stock according to the degree of its productiveness.

There is another point to be considered. The amount of dry fodder which an animal can eat daily is somewhat limited. When a cow needs less nourishment in view of its small yield of milk it can be fed in a rational way chiefly with local fodder containing a good deal of padding, but the better the milker the greater the percentage of the ration which must consist of the so-called concentrated and easily digestible fodder.

As an example, we quote the Swedish rules (framed on the basis of the so-called fodder units) for the feeding of a cow weighing about 525 kilograms which produces daily—

Milk.	Rough Fodder (hay, straw).		Sap Fodder (roots, chips).		Strong Fodder (oilcakes, bran).	
	Kg.	Percentage of whole ration. p.c.	Kg.	Percentage of whole ration. p.c.	Kg.	Percentage of whole ration. p.c.
Under 6 kg. ...	8	33	15	63	1	4
Over 6 kg. ...	8	16	38	75	4·5	9

This shows that a good milker needs double the percentage of strong fodder in the daily ration required by a poor milker, or according to weight 4½ times as much, and, further, that in shorter rations the sap fodder can be replaced by hay. Now our scarcity is principally in protein, and in strong fodder generally; but sap fodder, especially potatoes, is also less abundant in many places owing to the drought last autumn. To get rid of all the poor milkers would therefore mean cutting off the possibility of using immense quantities of rough fodder; we must proceed according to the locality, and those which in one district must unquestionably be delivered up to the butcher may in another be equally unquestionably retained.

The necessity for reduction, however, still remains, and with it the question how the selection of the animals to be killed shall be made. Among other great advantages of the recently started Control Societies is the fact that they have shown numerically what great differences exist in the efficiency of animals in the same herd and still more in different herds of the same district, in spite of similarity of soil, climate, and sale conditions. Even the "task of fodder utilisation," if such an expression is permitted, is quite differently performed by different animals.

To take only one example from numerous publications, the annual yield of milk of 20 cows belonging to the same society varied between 2542 and 5520 kilograms and from 100 kilograms of nutriment in the total ration between 144 and 237 kilograms of milk were produced. These figures do not show anything like the extreme limits of variations observed. The variations are caused by the fact that even in the same breed some animals digest the fodder less well or require more nutriment, which returns no profit, owing to greater liveliness or other reasons. These animals must be removed. Therefore it is most urgently to be desired that the farmers' local organisations (chambers, societies, etc.) should meet soon to decide what reduction of their stocks of cattle would best suit their circumstances, the quality of the animals to be struck out, and the time of their removal.

Here is an opportunity for the farmers to show public spirit and good fellowship, and not to manage each for himself, keeping only his own (as he often mistakenly supposes) interest in mind, but to take account of the needs of his fellow farmers and of the whole situation.

Perhaps it is no Utopian idea to suggest that they should help each other with fodder supplies within not too wide an area, setting up a sort of fodder commonwealth for a whole district so as to assure the prosperity and efficiency of all. From many quarters the use of the crops up to the limit of what is possible has been advised. Great drought has in many places limited this possibility considerably, but this makes it only more desirable to share the harvested fodder in a kind of common housekeeping until the new green fodder smooths away all difficulties.

Care must be taken lest killing off cows should overstock the market, probably entirely with lean cattle, and so cause an excess of meat which sends prices down, followed by the inevitable scarcity of meat. For this reason it would often be wiser to keep the animals for a time on only sufficient fodder for sustenance and so postpone the selling, or else the State and local authorities should regulate matters by buying and storing meat. Large quantities of beef could be smoked and further use could be made of the method of freezing, which has been brought to a state of high technical perfection; for this purpose the freezing chambers no longer required for foreign meat are at our disposal. The fixing of minimum prices would prevent damage to the farmer and at the same time an excessive consumption of meat. The difficulties put in the way of importing meat in the last few years have worked favourably in both directions.

The second question is, How are we to carry out the reduction of our stock of 25½ million pigs by about 35 per cent.?

We might be inclined to recommend a limitation of breeding and rearing pigs, so that the feeding with so-called absolute pig food or cattle food could be continued with the help of bran, grain-cleanings, house-refuse, brewer's grains, distiller's wash, husks, blood and meat meal, acorns, beech nuts, etc. But this would be exaggeration. Ignoring the loss in the utilisation of fodder, we may unhesitatingly continue to feed the pigs with food suitable for human consumption in addition to absolute pig-food. This applies also to skimmed-milk. Dairies in which a certain amount of skimmed-milk has hitherto been given to the pigs could not immediately find human consumers for it, and owing to its very perishable nature it needs to be used at once. Cheese-making cannot be introduced immediately, and even if it could an assured sale for the cheese cannot be counted on. No extensions worth mentioning of the drying and condensing of milk are practicable. We shall therefore have to continue the use of skimmed-milk for fodder to a somewhat large extent.

The case of potatoes is similar. Our potato crop is so enormously greater than the human consumption that large quantities remain for fodder. To give these potatoes to the pigs is to make the most profitable use of them, especially if they also receive food rich in protein, such as fish-meal, meat-meal, fodder beans, etc. On these grounds it is not only permissible but even necessary to continue to use skimmed-milk and potatoes for the production of pork.

In the necessary limitation of pig keeping we must proceed extremely cautiously and pay the most careful attention to the local conditions. On the whole, the only principle we can lay down is that very young immature animals should not be brought to market; moreover, the necessity of reducing the stock of pigs in the whole empire makes very different demands on the individual fatteners.

The great fattening businesses which have hitherto fed almost entirely with barley must adjust their operations to meet the loss of this fodder; to carry on the fattening with other purchasable fodder ought to be very profitable.

The case is different with the farmers who are also breeders and for the small landed proprietor who has hitherto kept only a relatively small number of pigs. Here it is possible to supplement the feeding of the animals to a somewhat great extent with fodder which can be described as farm refuse and which can only be utilised by keeping animals. Therefore such farmers should resist the temptation to limit their pig keeping too far, even if the price of potatoes rises.

Young pigs must not be stinted in their food. From the time they are weaned at the age of one and a half to two months up to the age of about four months they must receive an ample supply of the fodders which have been proved to have a dietetically favourable effect, such as potatoes, milk, barley, fodder-meal, etc. The daily consumption should be not less than 1·3 per cent. to 1·5 per cent. of the pig's weight. When the animal's weight has increased to 30 or 40 kilograms and the period of its greatest growth (per cent.) is therefore completed, the increase in fat begun and to a certain extent accomplished, its body is strong enough normally to utilise a poorer fodder at least for increase in size, even though it contains little digestible protein. For intensive rearing 4 kilograms of digestible protein or more per 1000 kilograms of live weight must be given from this time on, but the amount required for actual growth is less than half this. It is then desirable to provide rations which contain plenty of rough fibre, or padding fodder, which widens the alimentary canal and prepares the pig for negotiating larger quantities of nourishment during a possible late fattening. Such rations would be principally brewer's grains, dry chips, husks, pea pods, with the addition of chopped hay, especially hay from leguminous plants, some beet leaves, different kinds of chaff, etc. If no sugar beet chips are available, a small addition of fodder-sugar would increase the tastiness of the rations. That all suitable refuse from the farm or which can be obtained from other houses should also be used goes without saying. In this way, the animals can be kept for later consumption with little expense, and, even if later a final fattening with concentrated fodder could only be insufficiently accomplished, less immature meat would be brought to market than if the immature young animals were now put up for sale. If the war lasts a long time it will also be advantageous next year to end with late fattening the so-called period of running free when the "runners" have to seek a large part of their fodder in the fields. Where forest pastures are available they should be preferred, and in the general interest they should be open to everyone.

The maintenance of the young pig will, of course, not proceed everywhere without loss from the farmer's point of view. According to the researches of Meissl, Stohmer, and Tangl, a pig weighing from 100 to 200 pounds requires as so-called persevering ration (sustenance fodder) only four to five pounds of food per 1000 pounds live weight a day (while the young pigs for sale must receive from 12 to 13 pounds per 1000 pounds live weight), so that the small amount of growth which is necessary in order that their lives may not be endangered may take place. Only the fodder received beyond the persevering ration produces meat and fat;

the young animal forms more flesh and the older more fat, and in the first case live weight rises in greater percentage than in the second case.

Where it is not possible considerably to exceed the persevering ration, the keeping of young pigs appears to be unprofitable, but it is justified by the fact that the good prices obtained for them in the late winter give full compensation.

As regards breeding it is desirable that the farmers should not restrict breeding too much from the groundless fear that lack of fodder may make it impossible to utilise the little pigs. If several reports are not false, this fear has already gained ground too much. Even in times of peace we are accustomed to have sometimes a glut and sometimes a dearth of young animals and to see the price of pigs vary correspondingly, generally in two-year periods. The continual attempt to fit the breeding of pigs exactly to the circumstances generally takes effect too late and causes great loss. If we now restricted breeding to any great extent it might happen that the limited number of pig fattening businesses, whose preservation is possible and also necessary, could not be supplied with a sufficient number of young animals.

Therefore we must not proceed systematically in the same way in all districts. The extent to which pig breeding and fattening has been carried on hitherto varies considerably, and we must now proceed in varying measure with keeping and limiting the stock. Here also it is desirable that each should not act according to his own inclination and purely subjective judgment, but that the farmers within a wide district whose circumstances are somewhat similar should join together and act in accordance, on mutually agreed principles after the most careful consideration of the local conditions.

It is, of course, extremely important that the necessary reduction of the stock of pigs should not cause a glut and consequent fall in the price of meat, which would not only harm the farmer but also give a great inducement to excessive meat eating, to be followed later towards the spring by dearness and scarcity of meat. Considering the number to be killed, it is even more important in the case of pigs than in the case of cows that the State and local authorities should buy up large quantities of meat and store it.

4. *Breeding Small Animals*

It has been proposed that in order to increase our stock of animal foodstuffs we should extend the breeding of small animals as far as possible, especially the breeding of poultry and rabbits.

The adoption of this proposal would not only increase the animal foodstuffs but the poultry and eggs would make a more varied and pleasanter diet possible, a result which, owing to the importance of enjoyment and stimulation in human nourishment, is not to be despised. The possibility of obtaining an increase of food worth consideration by breeding such animals does not, however, exist.

For years we have endeavoured in every way to promote the breeding of poultry, and yet we have become increasingly dependent on the foreigner for our supply of poultry and eggs. To mention only one figure, in the first half of this year over 940,000 double zentners of eggs alone were imported into Germany, valued at over 106 million marks [£5,300,000]. If such sums could not be kept for the home production before, there is not much that can be altered now.

One thing further has to be added. The feeding of poultry, especially the rearing of chickens, requires foodstuffs some of which are suitable for human food (milk, eggs) and some of which could produce a larger amount of nutriment if they were given to the pigs. Hay, leaves, and greenstuff which is mixed with the food have more dietetic importance. Poultry cannot digest rough hay, while the ruminants, and to a certain extent pigs, can. A real gain in animal foodstuffs would only be possible where the poultry run about freely in the farmyard or garden, or ride on the wagons to the fields picking up seeds, insects, worms, and plants which would otherwise be quite useless. The keeping of small animals on any other lines might bring money in time of peace, but it is no means of increasing the amount of available human food.

There are probably many places where poultry keeping could be instituted with advantage. In many farms there is refuse suitable for poultry which is now simply wasted, but only too often there is no one there who is able to direct the breeding and feeding.

It is not difficult in a purely technical sense, but it must be learnt, and above all it requires practice and experience, real economy, which looks at every pfennig so that a modest nett profit may be gained in the end, and great interest in the matter for its own sake, which alone ensures that the many small duties will always be performed at the right time and with proper care. The proverb, "The eye of the master fattens his cattle" applies here too. Such leaders of the "poultry profession" as are fortunately to be found amongst our women in the country are not to be lightly set aside, and we must therefore be careful in giving our advice to start poultry keeping even where the absolutely requisite conditions are to be found.

What applies to poultry keeping applies on the whole also to the keeping of small animals. Only where the objective and personal requirements are forthcoming should it be practised.

Where this is the case we should be heartily grateful to the leaders of the profession if they would do their best to add their mite to securing our national food supply.

5. *Increase of Fodder*

At the present moment we lack large quantities of foreign fodder, and the use of home-grown bread corn as fodder is forbidden. Under these circumstances it is of great importance to our animals that the yield of other fodders be increased.

Besides the great quantities of fodder which have always been highly valued we have others which have hitherto been little used. These include beet leaves and potato plants, which provide very different fodder according to the care with which they are gathered and preserved.

Further fodder could be obtained if a larger proportion of the plants scattered as vegetable manure after the reaping of the main harvest were used as fodder instead of being ploughed into the ground.

The sowing of other plants should also be considered so as to make use of the period between the main harvests, for instance, late turnips, quick growing plants, such as a mixture of Chinese radish, white mustard, buckwheat, peas, and giant spurrey, or St. John's rye and creeping vetch.

Where meadow clover has not wintered well crimson clover should be sown in good time.

All these measures were recommended by the German Agricultural Society and by experienced farmers at the beginning of the war.

CHAPTER IX

UTILISATION OF AGRICULTURAL PRODUCTS

1. *Grain, Potatoes*

MUCH could be done towards meeting our deficit by making a better use of grain and potatoes. They are placed together here because they so often serve the same purpose, human food, cattle fodder, production of starch, and distilling.

Grain and potatoes are used very largely for feeding domestic animals. This is not so undesirable in the case of potatoes, of which we have more than enough, as it is in the case of grain, which is no longer available to the same extent.

Not only the so-called "back-grain," *i.e.*, the grain which together with the weeds is sifted from the good grain for grinding, was used for fodder, but also the good grain suitable for human food. It is difficult to estimate the amount of this grain exactly, because nearly every small farmer assigns part of his own harvest for fodder without having weighed it, but it would be no exaggeration to assume that about two million tons of rye suitable for human consumption are given annually to domestic animals for fodder, chiefly to pigs and oxen, and to a smaller degree to horses and poultry. As the conversion of grain into animal foodstuffs causes a loss of at least 50 per cent. of nutriment, this means a loss to human food of one million tons or more of grain.

The missing import of about two million tons of wheat is replaced by the prohibited export of (1913) about 600,000 tons of rye. As we may assume that the imported wheat was nearly all used for human consumption we have lost 1,400,000 tons of grain. Under these circumstances the use of grain for fodder, apart from back-grain, must be reduced to the extreme limit, even the necessity for a reduction of the stock of cattle must not deter us.

The Imperial Government has taken note of the state of affairs. On October 28th the Federal Council prohibited the use of rye and wheat for fodder on principle. It must be a matter of honour to every farmer to observe this prohibition in the interests of the defence of the empire.

Fortunately, a certain compensation can be found for the grain used as fodder. We can give more potatoes, especially if large quantities are saved from decay by drying, thus increasing the stocks at our disposal (p. 172). We can also use sugar beet chips (pp. 177–179). Obviously such a substitution is not immediately possible; we cannot simply give sugar beet chips instead of rye; there must be a sort of transformation of our whole feeding of stock, which, however, need not be prescribed because it will accomplish itself.

No inconsiderable amount of grain and potatoes is lost to human consumption by being used for industrial purposes. In making starch, in distilling, and in brewing there is always a loss of nutriment, even the remaining nutriment is lost to man so far as the starch and spirit are used for industrial purposes. As we must practise careful economy with everything which is suitable for human nourishment, we must now examine these industries to see how far they should be restricted or maintained.

Starch is used partly in the kitchen and for baking and partly for technical purposes, *e.g.*, for starching textile fabrics. The raw materials for its manufacture are grain and potatoes.

A none too small amount of grain is made into starch. In 1911, 33,810 tons of rice, 24,780 tons of maize, and 22,690 tons of wheatmeal were used in starch factories. Of these materials the rice and maize came from abroad and may therefore be regarded as missing, but care must be taken lest wheat, which is now so precious to us, should take their place. The preparation of starch from grain withdraws from human nourishment the very valuable protein which the grain contains; at least the attempts that have hitherto been made to use a part of this protein as human food (for instance, under the name of Aleuronat) have not yet had much success. The most advantageous use made of it is as gluten in cattle fodder. For all food and industrial purposes grain starch can be replaced by potato starch. As grain has the advantage of potatoes in a high protein content and in greater durability and as our stocks of wheat are not even sufficient for the bread we require, the manufacture of starch from wheat must cease unconditionally.

Potatoes are used to a much greater extent for the production of starch. In the year 1910–11, 1·3 million tons of potatoes were made into starch.

In the manufacture of potato starch nutriment is not destroyed to the same degree as in making grain starch. The use of potatoes for the manufacture of starch is justified by the fact that potatoes are very perishable. By making them into starch in the first months after harvest we obtain in a durable form a considerable amount of nutriment which would have been lost through evaporation and decay if the potatoes had been kept until the following summer. Drying, which is the best means of preserving potatoes, can only be used for a portion of the available amount, so that the manufacture of starch serves to supplement it.

The foregoing shows that the production of potato starch for human nourishment is not improvident, because the loss of protein which it causes is balanced by the saving of a large amount of nutriment from corruption. Potato starch is useful in the kitchen and for baking cakes. Its use in bread-making is open to the objection that it lowers the protein contents of the bread in a way not discernible to the consumer, but this shortcoming can be more than counterbalanced by using skimmed milk in place of water. Zuntz and Magnus-Levy have shown that such bread can be fully utilised, and owing to its cheapness skimmed milk makes the bread richer in protein without increasing the cost of its manufacture.

The technical use of starch should be restricted as far as possible. A large amount of starch is used for stiffening clothes and for the quite unnecessary dressing of linen and cotton fabrics for the market, especially for new clothes. A good deal is also used as paste for paper-hanging, and it would be a remunerative task to find some suitable substitute for this purpose; in any case, no small amount of starch would be released for human food.

Grain as well as potatoes is used for the manufacture of alcohol. In the year 1912–13, 3,753,265 hectolitres of alcohol were produced, and as alcohol has a specific gravity of 0·7936, this means 2,978,591 tons. About half this alcohol was drunk and the other half served the most varied technical purposes.

Grain is used for the production of alcohol in different ways. In the year 1912–13 and in previous years with normal potato crops, 88,850 tons of rye were used for distilling, and produced corn brandy for human consumption; smaller quantities of other bread corn were also used. In addition, about three times as much grain of kinds seldom used for human food, especially barley and maize, was employed chiefly as malt, which is indispensable in the preparation of potato alcohol.

The use of bread corn for the production of alcohol is extremely undesirable. A foodstuff so full of protein and so durable should be reserved for human nourishment, therefore grain distilleries, *i.e.*, those which produce alcohol from grain instead of its being simply a by-product in the manufacture of yeast, should be absolutely forbidden.

In the year 1912–13, 2,730,000 tons of potatoes were used for distilling with the addition of a considerable amount of grain in the form of malt. Is a restriction of the preparation of potato alcohol appropriate? In answering this question we must distinguish between the preparation of alcohol for drinking purposes and for industrial purposes. This is possible, because the alcohol intended for industrial purposes is made bitter and therefore undrinkable in order to obtain the duty compensation.

There are great objections to the use of potato spirit as a drink. On the other hand, in its nutriment value it is not so far behind the potatoes used in its preparation as might be thought. To a moderate extent, corresponding to its calorie contents, it can replace other nutrients. In distilling about 60 per cent. of the energy of the raw materials is transferred to the alcohol, 3 per cent. is lost in the evolution of yeast, and the remaining 37 per cent. remains as a valuable cattle food, called distiller's wash, about one-third of which returns in the form of meat and fat for human food. If the potatoes are used immediately for human food, about 15 per cent. is lost in peeling and cooking when they are prepared in the ordinary way, and 2 per cent. through being imperfectly digested. The potato peelings could, of course, be used as fodder, and so produce a part of their value in human food, but, as a matter of fact, it would often be impossible to collect them and give them to the animals. The loss of nutriment in the consumption of potatoes themselves is therefore not much less than in their conversion into drinking brandy and distiller's wash.

All the same, it is desirable that the frequently excessive drinking of alcohol should be restricted. Of course, we may not feel inclined entirely to deprive those who are accustomed to it at a time which imposes many sacrifices on the population and which may cause a scarcity of a number of ordinary stimulants such as coffee, tea, and cocoa, but we must remember that alcohol is a poison and a danger to the health of the individual, as well as in the long run to the health of the nation.

Other arguments apply to the alcohol used for industrial purposes. It is entirely lost to our food supply, and the third of the energy in the potatoes which is used in the form of distiller's wash for cattle fodder has little importance for human nourishment, as in the most favourable circumstances only one-third of it, or one-ninth of the energy in the potatoes, is regained in milk and meat.

We must therefore regard the extensive use of alcohol for driving motors as an evil, though within certain limits it is unavoidable. Owing to the dearth of petroleum and petrol, we are frequently obliged to use spirit to drive the motors for cultivating the fields and for other important tasks, but it is much to be regretted that spirit should have been recommended lately for purposes for which it could be replaced by other materials not manufactured from human foodstuffs. Particularly illumination should, wherever it is in any way practicable, be obtained from gas, acetylene, or electricity, and not from spirit.

At the same time, spirit is so indispensable to numerous industries owing to the lack of petrol and petroleum that we cannot count on any considerable reduction in the manufacture of potato alcohol, even if brandy drinking is restricted. We must be content if we are able permanently to prevent an increase in the manufacture of alcohol from potatoes.

It is a matter for congratulation that the Federal Council has fixed the so-called average brand, which is subject to a small tax, at 60 per cent. of the usual average brand or at 90 per cent. in the case of quite small distilleries, and correspondingly reduced the proportion for the distilleries of the reserve States to seven-tenths, and further that it has laid down the proportion of alcohol to be embittered as not less than 65 per cent. of the average brand produced. In this way, the manufacture of alcohol from potatoes is generally discouraged and the manufacture of drinking brandy is greatly hindered.

Grain only is used for the production of beer. Our population drinks more alcohol in the form of beer than in the form of brandy. In the year 1912–13 in the whole sphere of German customs 67½ million hectolitres of beer were drunk, or 101 litres per head of the population; with an average alcohol content of beer of 3·5 per cent. this would mean 3·5 kilograms of alcohol per head annually. On the other hand, the consumption of brandy in the financial year 1911–12 amounted to 2·8 litres per head of the population, corresponding to 2·2 kilograms of alcohol.

About 1,700,000 tons of barley were used for the production of beer in 1912.

The question as to the necessity for restricting the brewing of beer is influenced by the fact that we are accustomed to use very little barley for food, and mainly in the form of pearl barley.

In beer brewing, the nutriment in the raw materials is fairly well utilised, yet losses take place. These occur first in the transformation of barley into brewing malt. Nutriment is lost through the sweating of the barley during germination and when small quantities of barley are skimmed off, and also because some of the lye-washed material flows away with the water in which it was steeped.

Other losses occur in the removal of the rootlets and stems when germination is stopped; these are used only as a valuable fodder. Altogether a loss of nutriment occurs in changing barley into brewing malt amounting to from 9 to 15 per cent., according to the kind of malting process employed. We may put the average loss at 12 per cent.

The wort is prepared from the malt by boiling, and thus about another 25 per cent. of the nutriment in the barley is lost. The brewer's grains which are left as waste are a valuable cattle food.

In the further preparation of the beer only small losses occur. About 2 per cent. is used up in fermentation during the evolution of the yeast. Another small loss occurs in the attenuation of the beer with the yeast which has developed during fermentation. This, however is not an absolute loss because the yeast which was formerly mostly washed away has lately been made available both for human and for animal food; part of the yeast is used also in bakeries to make the bread rise.

We may therefore reckon that about 60 per cent. of the energy of the barley comes to man in beer. At first sight this seems unsatisfactory, but no less loss takes place when barley in the form of pearl barley or similar products is used directly for human consumption. In the preparation of pearl barley about a third of the barley becomes bran, which is only suitable for fodder, and even of the pearl barley only about 90 per cent. is digestible with the best preparation. In the direct use of barley as human food only 60 per cent. of its energy is profitable. Brewing therefore does not materially diminish the amount of nutriment available for man. As the nutriment of the beer consists not only in its alcohol contents but also in the other valuable nutrients which it contains, there is no reason to restrict brewing under the present circumstances.

The most important use of grain for human nourishment is in bread making.

The first thing to be remembered is that the available amount of wheat will be considerably less than hitherto owing to the missing import, and the amount of rye considerably more, as no export can take place and the use of rye as fodder is prohibited. It is therefore necessary that in addition to wheaten bread, more mixed or pure rye bread should at once be made, because a sudden change to pure rye bread due to the exhaustion of the stocks would have a bad effect on many people's health. The order of the Federal Council of October 28th, that wheaten bread must contain at least 10 per cent. of rye, is a measure to this end. This order is to be applauded, but it in no way meets our deficit in wheat. In fixing the maximum prices for bread corn the price of wheat might have been put above the price of rye, so that the consumption of wheat would have been limited, but this would have had the unpleasant result of assuring wheaten bread to the well-to-do and of restricting the poor entirely to rye bread. The Federal Council therefore did well to fix the maximum price of wheat not too high above the maximum price of rye. No further State measures are required; if the people are advised to limit their consumption of wheaten bread in favour of rye bread, and if the bakers make the favourite little rolls with rye flour, the making of wheaten bread will naturally remain within the limits necessitated by the situation.

Another important question is whether the amount of bread can be increased by a large addition of bran. By bran is understood the husks of grain separated from the meal in the process of grinding. They contain much protein but wrapped in cellulose which is difficult to digest. If the flour contains the whole of the bran, apart from the outer hard sheath, that is, if it represents almost the whole weight of the grain, it produces wholemeal bread when baked. The antithesis to this is the very fine bread made from flour wholly free from bran and weighing only about 60 per cent. or less of the weight of the grain. Between these there are many degrees of bread containing a larger or smaller proportion of bran and in which 70, 80, or 90 per cent. of the weight of the grain has been utilised. The more bran a loaf contains, the darker it looks. The bran separated from the meal can only be used for fodder and comes to man by way of the animal with a loss of more than 50 per cent., so that at first sight it seems best to make only wholemeal bread or else bread containing nearly as much bran as wholemeal bread in order that the whole of the nutriment in the grain may come to man.

A good many physiological experiments have been made in connection with this question, which show that a large amount of bran in bread, as is the case with Westphalian pumpernickel, lowers the utility of the bread considerably, or at least that there is some considerable difference in regard to the ability of individuals to eat a large amount of bran without harm. Improved methods of recent date, however, have made an extremely fine grinding of the bran possible and have thus enabled the human body to make a better use of it.

The preparation of very fine bread is a great waste, all the greater because such bread is mostly made of wheat, with which we must be particularly economical; on the other hand, it is not right to make only the so-called wholemeal bread.

The Federal Council had this in mind on October 28th when they ordered that the rye flour intended for bread must contain at least 72 per cent. of the total constituents of the grain and the wheat flour at least

75 per cent. of those of the wheat; but we should do well to exceed this measure somewhat.

The much-disputed question whether potato bread, *i.e.*, bread with an addition of potato, is suitable or not has been silenced for the present by the order of the Federal Council on October 28th that in every case 5 per cent. of potato meal must be added to rye bread. A larger addition is permitted, but in this case the bread must be distinguished by the letter K,[1] and if more than 20 per cent. is added the amount of the addition must also be marked on the bread.

The making of potato bread is not due to a lack of grain, for, owing to the prohibition of its use as fodder, we have quite enough for our requirements without the wheat hitherto imported, but to the fact that the greater durability of grain in contrast to the perishable potatoes makes it particularly suitable for storing as provision for the future. The use of potatoes in bread-making increases the consumption of potatoes instead of grain and so makes a saving of grain possible.

The objection to potato bread is that an important article of food like bread, the value of which as nourishment has been proved by centuries of experience, should not have additions made to it which change its traditional constitution to the disadvantage of the consumer. Many people are accustomed to meet their protein requirements largely with bread, and do not know that a large addition of potato interferes with this important function of the bread. Potatoes do not contain a fifth part of the amount of protein in rye flour.

Thus the preparation of potato bread with the prescribed addition of 5 per cent. is harmless. Potato bread with an addition of 20 per cent. is harmless if the price corresponds to its poorness in protein and the greater cheapness of potato flour. Potato bread with an addition of more than 20 per cent. is objectionable. According to experiments by Hellsten, a large addition of potato diminishes the utility of wholemeal bread.

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[1] K here stands for Kartoffel (potato), but the bread is often called Kriegskot (war bread).

Another, though modest, saving of nutriment could be effected if we could make bread rise without yeast. Yeast makes the bread rise by changing a certain amount of starch and sugar into carbonic acid and alcohol, which make the dough swell. As this alcohol evaporates in the baking about 2 per cent. of nutriment is lost in this way.

It will, however, not be easy to deviate from this method of making bread. So-called baking powder has occasionally been used and also pressing carbonic acid into the dough with the help of a special apparatus, but as bread raised by fermentation undoubtedly has a pleasanter taste, as the gain in nutriment is very small, and the success of the baking presupposes a certain experience, these methods will not attain any great importance.

The complete utilisation of potatoes is difficult, because a part of their nutriment is lost through evaporation if they are stored for any length of time, and also because a not inconsiderable number are ruined by rot. The losses are small in the first months after the harvest, but they rise rapidly towards the spring. The amount of potatoes which is lost to our food supply in this way has been estimated at four million tons a year.

These losses can be greatly reduced through proper storing. Tubers and roots must lie cool and dry. The best method of storing potatoes for the winter is the clump, with impervious top on a loose, well-drained soil in a sheltered spot near the farm yard.

In the last few years drying has also been practised to save potatoes. There are two methods of doing this. In one, the potatoes are cut into pieces and the chips dried by hot air. In the second process, the potatoes are damped and peeled and then dried into thin slices by being passed between steam-heated rollers. These little slices taken from the rollers, the so-called potato flakes, have not only proved more efficient than the chips for pig food, but they are also very suitable for human consumption.

Potato drying has the special advantage of reducing the weight of the potatoes to nearly one-fourth, so that it is possible to convey them to a distance, and thus make use of the superfluous potatoes in any district.

The economy in foodstuffs necessitated by present circumstances makes it desirable that potato drying should be widely extended, and we are glad that State assistance has made it possible to set up numerous drying apparatus this autumn. Of course, these apparatus, even if they worked day and night until the beginning of the warm season, would not be able to dry more than 2½ million tons of potatoes. It is therefore extremely urgent that the number of machines should be increased by at least half as soon as possible.

2. *Green Vegetables, Fruit*

We could obtain a not unimportant increase in our foodstuffs by making better use of our green vegetables and fruit.

There are several things which would serve excellently as vegetables which are now wasted in many parts of Germany, for instance, our edible fungi; but above all we can preserve large quantities of the vegetables now imported, thus making their use easier, and rendering their consumption independent of the place and season of their production.

For this purpose there are four methods to be considered, of which sometimes one and sometimes another is to be preferred, according to the kind and price of the vegetable—storing, pickling, drying, and bottling.

The simplest method is to keep green vegetables in their natural condition by storing them in suitable places which afford protection from damp and cold. This is a simple and cheap way of preventing a large amount of certain vegetables, especially cabbage, being thrown on to the market in late autumn at low prices, which lead to their being used with insufficient economy. In Holland, the farmers have already used this method for some time, and we have already begun to follow their good example, *e.g.*, in the Rhine Province. The storage of vegetables for the winter in rooms protected from frost must, however, be more fully employed, and for this purpose the farmers should act in concert as they do in Holland. Where the means for building the barns are not forthcoming the public bodies, especially the local authorities, and perhaps also the Central Co-operative Bank, should give their support.

Another simple method which is far too little employed is the pickling of vegetables. This is generally limited to pickled cabbage (Sauerkraut) and beetroot, but in many districts it is used for other vegetables. This deserves imitation.

Drying is more complicated. It makes the vegetables very durable, and has also the advantage of considerably reducing their size and weight, so that they are easier to store or send away. This method should also be employed to a much greater extent than it has been.

The most complicated, dearest, and therefore least used method is that of preserving in tins and glasses. At a time when the demand for vegetables is sure to increase considerably and when labour is cheap owing to unemployment, this method is capable of great extension. The opportunity should be seized for employing this method for the cheaper kinds of vegetables as well as for the finer kinds hitherto preferred.

These four methods, by supplementing each other, make it possible to check the enormous waste of vegetables through decay and put these foodstuffs at our disposal at all seasons in good condition and at low prices. They can nearly always be employed in private houses and would give a new task to our housekeepers, who are now deprived of so large a part of their former activities by modern science. If they were adopted on a large scale they would cause a considerable extension of our food industries, particularly the preserve factories.

The case of fruit is similar to that of vegetables. Of late years we have imported large quantities of garden fruits from abroad (p. 47) and have not made a sufficient use of our own. For years there has been a complaint that no organised market exists for inferior garden fruit, especially for windfalls, and also for less valuable apples, plums, etc. The result is that very large quantities (though they are difficult to estimate) of such fruits are lost to our food supply; they are either left to rot or are given to the pigs, in which case only a small percentage of their nutriment comes to us.

It is the same with wild fruits (bilberries, blackberries, cranberries, hips, rowanberries, elderberries, and many others). Of these fruits also large quantities have been imported from countries which know their value, while we have in no way made full use of our own riches. Of course, in some districts they are carefully gathered; in others, particularly in the thinly-populated mountainous districts, berries and wild fruits are left to shrivel. This is due partly to a certain contempt for anything that grows without trouble, as is shown by the fact that country people often do not gather the wild fruits for their own use; but far more to the absence of an organised market which also prevents a full use of the inferior garden fruit.

Some wild fruits and lesser garden fruits have little or no taste when raw, and others are so perishable that it is difficult to use or pack them, but with the help of sugar they can be made into a very valuable food, which keeps good for a long time and is easy to send away. This procedure has the further advantage of causing the necessary increase in the consumption of sugar. When the inferior garden fruits, windfalls, bilberries, cranberries, raspberries, hips, etc., are everywhere made into jam, fruit jellies, and fruit syrups, they will become marketable goods.

These products are of great value to us at a time when we must restrict our consumption of fat and prepare for a later restriction of our consumption of meat. Besides their worth as nourishment, they are distinguished for their wealth in useful minerals and for their pleasant taste. Food made of flour or potatoes can be made more enjoyable by adding tinned fruits, jam, or fruit jelly. Not only the children, but also adults, will agree to the meat being now and again replaced by pudding with fruit.

The boiling and preserving of fruit with sugar must be promoted by comprehensive instruction. For this purpose two of the collaborators in this memorial have published a pamphlet which the National Women's Service has sent to nearly all the women's societies in Germany, and which has had a most gratifying success.

3. *Sugar*

We must also seek for new ways of utilising sugar, because we have to make use of the sugar hitherto exported (more than one million tons) as well as of the amount ordinarily consumed in the country.

For this purpose, the means already recommended for the better utilisation of our fruit can be considered: the present beginnings of a fruit-preserving industry in Germany should be developed on a large scale. This could easily be done if the State lowered the sugar tax and facilitated the transport of the sugar and fruit to the factories by tariff exemptions. Securing a receptive home market, in the widest sense of the term, is a matter of vital importance to the sugar industry, because after the war it will be doubly difficult, in view of the competition of cane-sugar and Russian beet-sugar, to retain the English market, which was already difficult to hold.

As we are obliged to deprive the animals of some of the important fodder which they have hitherto received, we might think of using some of our wealth of sugar as fodder.

A greater use of sugar as fodder has the immediate advantage of supplying the animals with a valuable nutrient, but it has another still greater indirect advantage in enabling us to give them a large amount of tasteless fodder which could not be given in sufficient quantities by itself, such as beet chips from which the sugar has been extracted, straw, chaff, and the inferior kinds of hay.

A question arises as to the form in which the fodder shall be given. We naturally cannot think of using sugar which has already been refined and is therefore burdened with the expense of much labour, so it has generally been given only in the form of molasses, that is, the syrup produced in the manufacture of sugar from which no further sugar in solid form can be separated. Only when sugar has been very cheap has the so-called third product, *i.e.*, the least refined raw sugar, been given also. During the war the whole of the molasses obtained in the manufacture of sugar will be used as fodder, but the use of the third product, which was only made in times of a superfluity of sugar, can scarcely take place to any greater extent.

It has been suggested that in order to save labour and expense sugar beet should be given direct, but sugar beet is not such a digestible fodder that it could be given to cattle in any great amount. Experience has shown that the health and efficiency of the animals are unfavourably influenced by large feeds of sugar beet. We are inclined to regard the saponin in the beet as responsible for this. In any case, caution is necessary, and we do not recommend that the following maximum figures should be exceeded:—For milch cows per 1000 kilograms live weight about 10 kilograms, fat cattle 15 kilograms, farm horses 8 kilograms, fat sheep 25 kilograms. Pigs can digest sugar beet best, but even in their case 25 kilograms per 1000 kilograms live weight should not be exceeded, and for bearing sows or sows with litters not more than from 15 to 20 kilograms. It is best to cook the beet; otherwise they can only be coarsely chopped. In using sugar beet as fodder it should be realised that they are very poor in protein and therefore always require a sufficient addition of a protein rich fodder.

It must be added that fresh sugar beet travel very badly and lose a great deal if they are kept for long. In order to use them to a greater extent without loss, they would have to be dried, though there are probably great technical difficulties in the way of this suggestion, and the expense of transport would be considerable, so that, even if it were advisable, the use of sugar beet as fodder can generally only take place where they are grown, *i.e.*, to a very limited extent.

The direct use of a large amount of sugar beet for fodder would also have economic disadvantages. In Germany there are well over 300 sugar factories which employ a great number of workmen. If these factories were deprived of large amounts of sugar beet the result would be that many of them would have to reduce their business, and some would have to shut down altogether. Although under present circumstances this must not be the deciding point of view, it is supported by the fact that sugar beet is only suitable as cattle food to a limited extent.

There is a more practical way of giving additional sugar to stock, namely, by not extracting all the sugar from the beet chips. At present in most factories the beet chips have their sugar entirely extracted; others have used for years with great success Steffen's scalding process, which leaves about 20 per cent. of sugar in the beet chips; when dried, these chips make an extremely digestible and durable cattle food. This process, or a similarly incomplete extraction of sugar in the ordinary diffusion process, is the right one. The so-called sugar chips are obtained in the simplest way, they make a fodder which is agreeable to animals, chiefly owing to its taste, and which has a favourable effect on their health, and they possess the advantage of being durable and travelling well.

As has been shown on pages 159–160, during the war we must not use as fodder any kind of grain suitable for human food, and the sugar chips can to some extent compensate for this deficiency in valuable fodder.

4. *Milk*

A product the better utilisation of which would result in a considerable gain to our national food supply is milk.

Before the war we produced yearly about 20 milliard litres of cow's milk, excluding the milk drunk by the calves. At present we must reckon that even with the wisest economy our milk production will decrease by about 10 per cent., *i.e.*, to about 18 milliard litres. Of this milk we used about two-fifths directly as full milk, a small quantity was made into cheese, and more than half into butter. Butter making causes a great loss of nutriment.

Butter making is a separation of the milk by which almost the whole of the fat contents are transferred first into the cream and then into the butter, while the whole of the carbohydrates and protein remain in the skimmed milk and in the much smaller quantity of butter milk (p. 71). Milk contains about 3·5 per cent. of fat, 3·2 per cent. of digestible protein, and 4·8 per cent. of carbohydrate. As fat contains more than twice as many calories as protein and carbohydrates, the greater part of the energy contents of the milk goes into the butter. On the other hand, almost the whole value of the milk as body-building material lies in the protein which remains in the skimmed milk. With the present extent of our butter making, from 8 to 9 milliard litres of skimmed milk are produced yearly, so that it is clear that skimmed milk could be of enormous importance in meeting our protein requirements.

Unfortunately, skimmed milk is at present only available to a very small extent for human food. One very common use of skimmed milk as human food is the making of skimmed milk cheese: the pure protein (the casein) is separated and part, which has begun to ripen, is sold as whey cheese, and part, in a state of advanced ripeness, is sold as skimmed milk cheese (Harz cheese, beer cheese, etc.). Skimmed milk is also used largely in the manufacture of margarine; here only a part of its nutriment remains in the margarine, and the rest is only suitable for pig food.

Skimmed milk has made little headway as a drink, even less than butter milk. In a raw state it is more capable than full milk of carrying tubercle bacilli, and therefore (as is frequently the case) it should only be admitted for sale in a pasteurised or sterilised condition. It also has not a particularly pleasant taste, but it has not up to the present obtained due recognition in the kitchen as a substitute for full milk in the preparation of puddings and soups, where the cooking makes the pasteurising superfluous, and for which it is often very suitable.

There are various reasons for this. Hitherto, in view of the large consumption of meat, the need of milk has been so small that it could easily be met by the available full milk. Most housekeepers do not sufficiently realise the usefulness of skimmed milk, and therefore there is no great demand for it. This is the reason why the path of skimmed milk from producer to consumer has not been smoothed and why there are no arrangements for bringing such a perishable product into the hands of the consumer in good time, and it also accounts for the fact that at least in the cities the small amounts of skimmed milk on the market have in comparison with full milk a disproportionately high price.

At present, therefore, by far the greater part of skimmed milk (about five milliard litres) is given to the pigs. This means a considerable loss of nutriment owing to the losses during its transformation (p. 86–88).

There are three means of keeping at least the greater part of this nutriment. The first is that skimmed milk should be more commonly used as a foodstuff. The value and great adaptability of skimmed milk as a substitute for meat should be explained to housekeepers. The railway administration should do its best to introduce this excellent foodstuff by cheap tariffs and quick transit. Then the dairies and milk trades would find that it paid them to organise the sale of skimmed milk, and this would not interfere with the sale of full milk, which serves quite different purposes. It is, of course, necessary, in view of its nutriment value, that the price of skimmed milk should be less than half that of full milk, but this will be possible when large organisation of its sale has made it a national foodstuff.

The second means of utilising skimmed milk for human food is by increasing the making of cheese, first of whey cheese, and then of the many kinds of skimmed milk cheese. In order to make whey cheese more popular, a propaganda is required to draw the attention of the public to the fact that this cheese is not only very good as an addition to bread, but that it can be used in the most varying ways in the preparation of excellent hot dishes. The ripe skimmed milk cheeses already enjoy great popularity among rich and poor, and if meat is scarce they will be more and more widely eaten.

The third and most efficacious means of retaining the nutriment at present lost in skimmed milk, is to limit its production, or, what means the same thing, to limit the production of cream and butter. Even with the greatest care we cannot prevent our yield of milk decreasing by 10 per cent. because of the dearth of fodder. This decrease must not result in a similiar reduction in all dairy produce, but must apply to those products in which the milk is used to the least advantage in human nourishment, that is, cream, and, above all, butter. As rather more than half our milk is at present made into butter, the production of butter must be reduced by about one-fifth. A greater reduction will hardly be possible in view of our lack of other fats.

The production of rich cheese should under no circumstances be reduced, it should rather be extended. Rich cheese is a better foodstuff than butter, because it contains almost the whole of the protein of the milk as well as the fat. For the producer it has all the advantages of butter, it travels well even for great distances, it obtains good prices, there is a well-organised market for it, and it has the additional advantage of being very durable. The consumption of rich cheese should therefore be considerably increased. The best means for this is a propaganda calling the attention of the public to the great value of this nourishing foodstuff, especially when meat is scarce. This recommendation could easily be combined with the recommendation of whey cheese and skimmed milk cheese. The increased demand for rich cheese would then naturally result in a greater production. It is true that the necessary appliances and experience will not be available wherever butter has hitherto been produced, but an increase in our production of cheese is nevertheless immediately possible.

In view of the decreased production, an increase in the consumption of full milk in its natural state will hardly come into consideration. Children, particularly of the poorer classes, should of course be given more milk instead of coffee, bread and butter, and meat, but for this purpose the consumption of the adults can be restricted by using skimmed milk instead of full milk in cooking. Otherwise the consumption of this valuable foodstuff should under no circumstances be diminished.

The result of the foregoing as regards the utilisation of milk is as follows. Full milk must be sold to its usual extent; the production of cream and butter must be reduced; cheese must be made where possible to an increased extent; as much skimmed milk as possible left from buttermaking must be made into whey cheese and skimmed milk cheese; and the immediate consumption of skimmed milk must be promoted by propaganda and cheap prices.

5. *Meat, Fat*

The absence of foreign fodder is of importance in connection with the utilisation of meat.

We must reckon that, so far as local conditions allow, and where it can be done without too great a destruction of values, our stock of pigs will shortly be reduced by more than a third, and our stock of milch cows by about a tenth (pp. 133–145). This is not only necessitated by our economic position, but our farmers are certain to come spontaneously to the decision under the pressure of the high price of fodder. A large supply of cattle and meat is already noticeable, and even if the consumption of meat should be widely restricted in favour of cheaper foods, it is not impossible that a larger supply may lead to falling prices and an increased consumption of meat. If this happens, the reaction will be all the greater when the stock of pigs has been reduced, and will make itself felt in the scarcity of meat and high prices. We must therefore endeavour to obviate such fluctuations in market conditions, which harm the farmer in the first place and later the consumer also.

To do this the supply must be distributed over a longer period. We must try to restrain the farmers from a blind and too hasty slaughtering of their live stock (pp. 150–152). Where the killing of the live stock cannot be avoided, what is otherwise done by keeping back the living animals must be accomplished by keeping back and preserving the meat. Suitable means of doing this are by storing the slaughtered animals in the available cold chambers, preserving according to Emmerich's process, and, as pork is chiefly concerned, smoking and pickling and the manufacture of "*Dauerwurst*" (durable sausage). Preserving in tins has no great importance in connection with the general meat supply. It would be of great use if the farmers themselves would revive on a larger scale their old custom of preparing ham, sides of bacon, and sausages.

Perhaps the expectation of a scarcity of meat may alone cause the superfluous amounts of meat to be bought up at suitable prices and preserved, but if not and if the price of meat threatens to fall too low, the local authorities, and if necessary the State, must interfere in the interests of agriculture as well as in the interests of a permanent meat supply for the population, and must buy up large quantities of meat and have it preserved.

As regards fat, its use for industrial purposes must be restricted as far as possible. This concerns the manufacture of soap and candles, the production of oil-colours, and many other small trades. The soap factories must under no circumstances use fat suitable for human food. If this is not prevented by the rising price of fat it must be prohibited by order of the Federal Council.

The soap factories have many opportunities of managing without edible fats, for instance, they could use the fat in sewer water. Although it is to be hoped that economy in housekeeping will reduce the great amount of fat in town sewers (p. 91), it would still be worth while to obtain material for the manufacture of soap from sewer water. A method of obtaining fat from the clearing basins of town drainage works was worked out some years ago by Bechhold and others, and in Elberfeld-Barmen there is already an experimental ground. Similar arrangements in other towns are now urgently desirable.

It would probably be more profitable if the collection of fatty refuse, particularly in the towns, were encouraged. Perhaps the so-called pig food which is collected in the towns but which frequently finds no useful sale might produce fat for industrial purposes. The existing establishments for the utilisation of the dead bodies of animals should with a more complete utilisation be able to provide more fat for such purposes as well as more bone-meal.

Finally, the question of additions to soap has to be considered. Already many so-called filling materials are added the cleansing properties of which are mainly mechanical. Naturally such "filled" soap is correspondingly cheaper.

In the same way as in the soap industry, other industries which have hitherto used fat for technical purposes must as far as possible give up the use of edible fats and seek substitutes.

CHAPTER X

CHANGES IN OUR STANDARD OF LIVING

1. *More Vegetable Food*

EVEN isolated Germany can meet its requirements in foodstuffs. If this is to be done without too great restrictions, there must, of course, be many adjustments both in the agricultural production and in the use of agricultural products. A certain alteration in our way of living necessarily follows.

If manufacture and commerce do their best to fit themselves to the altered conditions, the consumer will be compelled to change his way of living, but the consumer can also do much of his own accord to adapt our economy to the situation. He can begin by resolving to change his ways, and showing a preference for the foodstuffs which are available in excess, such as rye meal, sugar, and skimmed milk, thus inducing commerce to provide them. A great part is therefore entrusted to the consumer in fighting the English starvation scheme.

The most essential change required is that protein and fats must take a less prominent position in our diet compared with carbohydrates. Such a form of nourishment differs considerably from what the townsman is accustomed to, though in the country, especially in South Germany, the carbohydrates already play a greater part. Hitherto in many parts of the country, particularly in the cities, plenty of protein has been eaten, mostly in the form of meat. Now we can harmlessly reduce our excessive consumption of protein and make a greater use of other foodstuffs. This is necessitated by the situation.

We must expect that meat will become scarce in time, for we have lost a large amount of fodder with which we produced meat. Of course, we may shortly expect a superfluity of meat because an unusually large number of animals, particularly pigs, will be slaughtered owing to the lack of foreign fodder making a reduction of live-stock necessary. We should, however, do well to keep in mind not only the immediate future, but also the more distant future, and should make no use of this gift of chance. A decrease in our consumption of meat is in no way a misfortune. In the course of the nineteenth century the consumption of meat has risen very much. The annual production of meat in Germany per head of the population amounted to:—

Year.	Kilograms.	Year.	Kilograms.	Year.	Kilograms.	Year.	Kilograms.
1816	13·6	1861	23·2	1883	29·3	1900	43·4
1840	21·6	1873	29·5	1892	32·5	1907	46·2

In the last ten years the consumption of meat per head has remained about the same, but we now eat twice as much meat in proportion as we did fifty years ago. Our consumption is greater than that of most other nations, and we could without harm approach the customs of our fathers. We should then live very much more healthily and certainly more cheaply.

Fat has also been very largely eaten in the last few years, again especially in the cities, in the form of bacon, lard, suet, margarine, butter, and cream. So far as nourishment is concerned, fat only differs from the carbohydrates in its greater calorie contents, so that 40 grams of fat can be at once replaced by 90 grams of carbohydrates (pp. 22–24). We can considerably restrict our consumption of fat and in its place eat more carbohydrates, *e.g.*, bread, pudding, soups of various kinds, potatoes, sugar, etc. This must be done.

We shall soon have a scarcity of fat. We have lost the foreign animal fats, *e.g.*, the American lard and the Siberian butter; also foreign fodders, especially oil cakes, barley, and maize, with which we produced animal fats in this country, and finally the foreign vegetable fats which we used in the manufacture of artificial butter.

There is no prospect of making up this deficiency in fats to any great extent. We might, of course, revive the consumption of some native vegetable fats, such as linseed oil, which in Silesia is widely used in roasting, and as an addition to bread and potatoes. We might also use some hitherto entirely neglected fats, such as beech-nut oil and the very pleasant tasting sunflower oil; but the production of these would first have to be increased, and this could not be done to any extent before next year at the earliest; and even then their use could not play any considerable part in view of the enormous loss of fats of all kinds.

Meanwhile, a decrease in our consumption of fat is desirable. A large consumption of fat is as unhealthy as it is uneconomical. It is unhealthy because the pure fats, in contrast to most other foodstuffs which are rich in carbohydrates, are very poor in other important nutrients, especially mineral substances. A further objection is that they are indigestible and unappetising and invite the drinking of alcohol; the favourite Schnaps (brandy) after fatty dishes has indeed a good physiological reason, but its regular repetition is hygienically extremely harmful.

A large consumption of fat is uneconomical, because with no foodstuff is the danger of waste so great as it is with fat. This is due to the fact that the fats used in boiling and roasting, especially beef suet and mutton fat, remain sticking to the utensils when they are cold, and are not saved because they do not taste nice. The amount left in the pans and on the dishes and plates is simply enormous. Rubner's demonstration that 20 grams of fat per head of the population, that is, 100 grams of fat for a family of five, appears daily in the Berlin sewers, can be understood by anyone who has ever noticed how much fat is thrown away or rinsed away, even in the kitchens of the working classes. It would therefore be a matter for congratulation if the pressure of circumstances should bring the oft-repeated wish and counsel of the national hygienists nearer to realisation, and the use of fat both for cooking and for spreading on bread were considerably reduced in favour of the carbohydrates.

We must eat less protein and fat and more carbohydrates. As the animal foodstuffs contain more protein and fat and the vegetable foodstuffs more carbohydrates, this means that we should live more on vegetable foods.

Pure vegetarianism is in no way recommended. In poor households and in the people's kitchens meat and animal fat need not disappear from the table even if the war lasts a long time. To renounce animal foodstuffs completely would be an economic mistake. Animals eat, besides food suitable for man, numerous things which they can digest but we cannot, for instance, hay, straw, chaff, leaves, acorns, beet chips. These things only become serviceable to man by way of the animal; they would be of no use to us if we gave up eating animal food entirely.

We should, however, avoid an excess of animal food. We ought to return to the customs of former times when vegetarianism had no meaning because the consumption of meat and fat had not grown to anything like its present extent. Such a way of living need not now be introduced into large portions of Germany. In a great part of South Germany the vegetable foodstuffs which are rich in carbohydrates already dominate the diet, particularly in the form of many good soups with additions and numerous puddings. We can therefore say that the change required in North and Middle Germany consists in the introduction of South German food.

The change in our diet should not take place suddenly. An alteration of the accustomed food is no matter for indifference, even if the new ways are as good or better than the old. Many people regard not only an insufficiency of food, but also the lack of their habitual foodstuffs as a privation. This is illustrated by the fact that people of better means who fall on evil days do not make a thorough change in their food; they try rather to find a middle way between that necessitated by their circumstances and what they are accustomed to, with the result that they often become a prey to a real privation, underfeeding.

It is therefore necessary, particularly in the cities where food is rich in protein and fat, that the transition to food rich in carbohydrates, such as must come sooner or later when our stock of cattle has been reduced, should be made gradually and begun now when as yet such a transition is not compulsory. At present the dearth of fodder has brought many cattle and a good deal of meat to market and this has caused a fall in prices. If we now seize this opportunity of once more eating animal foodstuffs to our hearts' content, in a few months the lack of these foods with correspondingly high prices will compel a sudden change in our way of living.

Such an abrupt transition could be avoided by a proper course of procedure on the part of the State and the local authorities. Their aim should be (p. 185) that no drop shall occur in the price of animal foodstuffs, but that prices shall rise. The best means of doing this is taking up and preserving large stocks; this is required not only in the interest of the producer, but also of the consumer. If need be, fixing minimum prices for meat, though in itself undesirable, could be considered. If such measures should have to be taken soon, the townsman must not see in them a prejudiced regard for the interests of the much-abused agriculturist but rather a just perception of the interests of the consumer; they would be enforced in order that a period of cheap prices and plentiful meat should not be followed swiftly by a time of dearness and a great reduction in meat eating.

2. *Meat, Fish, Milk, Cheese, Skimmed milk, Pulse*

The need of our bodies for building material, that is, for protein, is partly met by such foodstuffs as bread, and to a smaller degree by potatoes, which, though they are chiefly important for the carbohydrates in them, also contain protein. As we eat large quantities of these foods they afford us no inconsiderable amount of protein in spite of their small protein contents. We should of course have to take an excessive amount of them to meet our whole protein requirement by them alone. For this reason we are accustomed to meet part of our protein requirements with foodstuffs which have a large protein content. This applies to three groups, meat and fish, milk and milk products, and in the vegetable kingdom really only pulse.

The consumption of meat varies very much in different parts of Germany. In some districts, especially South Germany, little meat is eaten, in the country often only on Sundays. In other districts too much is eaten, particularly by the wealthy classes; and in the cities, and, more than anywhere else, in hotels and restaurants, an excessive consumption of meat takes place. The so-called English breakfast, which begins the day with an abundant amount of meat, etc., is an excess, and it is also an excess when plentiful meat additions are taken at the between-meal in the forenoon, and when even the children are made accustomed to it; in many cases this only leads to a proper midday meal being no longer eaten.

Where meat eating is now within moderate limits it can be continued to the same extent. Meat is always available in many forms; besides beef, pork, and mutton, there are horseflesh, game, poultry, and rabbits, and we may also count fish as meat, fresh-water fish as well as salt-water fish, but especially herrings, haddocks, and cod, which even during the war are still caught in plenty. One of the cheapest sources of protein is dried fish (dried cod, salted cod), which are much liked in many districts, although it certainly requires some experience to prepare them tastily. The herring catch of the past year was abundant, and we may therefore assume that there is still a large amount of excellent preserved herrings in the country. Fish is of great assistance in bringing the desired variety into the food of the less well-to-do.

The excessive consumption of meat which has gained ground in many districts and in many classes of the population, but above all in hotels, should be considerably reduced. Adults may continue to obtain a part of their protein requirements, according to custom and means, by eating meat, but in the case of children it is better to replace meat with milk and milk puddings, even after school days have begun.

By far the most important substitutes for meat are milk, cheese, butter-milk, and skimmed milk. Milk plays an unrivalled part among foodstuffs. As its natural purpose is to serve as the only food of the young living thing in the first period of its growth, it contains all that the body needs for building and for meeting its energy requirements, milk protein as well as milk fat and milk sugar. Under the present circumstances its protein content is of special significance.

Milk is enjoyed in many forms by man, first, as full milk; secondly, in the form of rich cheese which is almost equal to full milk in nutriment because it contains nearly all the constituent parts; thirdly, as butter, which contains only fat, because the protein and sugar are separated from the milk; fourthly, in the form of whey cheese made from skimmed milk and also the skimmed milk cheese produced by ripening whey cheese; fifthly, in small quantities as butter milk and skimmed milk.

The consumption of butter should be restricted because its production means a considerable loss of protein to man owing to the separation of the skimmed milk, which is mostly given to live stock (p. 182).

We can hardly increase our consumption of full milk, but on the other hand it must not decrease (p. 183). There should be a certain rearrangement in the consumption of full milk; the children should receive more as a substitute for meat, and it should be partly replaced by skimmed milk in cooking.

The consumption of cheese must be increased. Rich cheese is, so to speak, concentrated milk; it contains in a handy form nearly all its valuable constituents, and is more nourishing than meat of medium fatness. Rich cheeses have the advantage over milk in their strong and varied tastes, and, at least for many people, greater digestibility. As nutriment, milk costs only about half as much as meat and the rich cheeses; at any rate those large hard cheeses, such as Tilsit, Swiss, Allgäuer, and Dutch, which alone can be considered in connection with wholesale consumption, are somewhat cheaper than milk because they are easy to transport, and keep well.

It is still more important that in future the very cheap cheese made from skimmed milk should be used to a greater extent. The actual skimmed milk cheeses, *i.e.*, the fully ripened, such as Harz cheese, Mainz hand-cheese, and Munich beer-cheese, are already the poor man's cheeses. When it is more generally known that their great protein contents and strong taste make them an excellent and extremely cheap substitute for meat, cheese sandwiches will more and more take the place of sausage sandwiches. The eating of whey cheese is unfortunately far too uncommon. In contrast to the ripe cheeses, whey cheese tastes rather mild, but this is just what makes it fit for the most varied uses. By adding sugar, caraway, or chives it can be made into most tasty cold dishes, and should therefore be extensively used, particularly at breakfast and supper and for children, but where its suitability as a substitute for meat merits special attention is in its usefulness in cakes and hot puddings, as may be seen in the curd dumplings and *Topfenstrudel* of South Germany and Austria.

It is, however, of very great importance that the skimmed milk itself should be used to a large extent as a substitute for meat. It can contribute very much to meeting our protein requirements. It is not common as a drink, but is excellently suited for boiling and baking and could often replace the dear full milk. We should accustom ourselves to every possible kind of sweet pudding prepared with skimmed milk. These do not differ in taste from puddings prepared with full milk, and as they combine high protein and carbohydrate contents, pleasing taste, and easy digestibility, they make an excellent food for children and also for adults on days when little meat is eaten. For years hygienists and political economists have demanded a restriction of the too abundant consumption of meat and fat in nearly every class of the population, especially in the cities. The introduction of puddings which fully replace meat with the skimmed milk they contain and fat with their sugar and flour, is not only necessitated for the moment as an expedient in grave times, but is a means of permanent improvement in our national nourishment.

Much less important as substitutes for meat are certain vegetable foodstuffs distinguished by their high protein content. Among these, the most important is pulse—

peas, beans, and lentils. They contain the same amount of protein as meat, although in them it is not so digestible as in meat and milk owing to the hard husk, but most of it can be made digestible by boiling the pulse to a pap, as is generally done with peas. Pulse is a cheap substitute for meat, and therefore it would be well not to give it up, even if it should rise considerably in price. The demand would induce the farmer and the merchant to send larger quantities to market.

Nuts, edible chestnuts, and fungi are also noteworthy for their high protein contents. Unfortunately, the fungi are difficult to utilise because their nutriment is enclosed in exceptionally hard covers. In view of the small amounts available, nuts, chestnuts, and fungi are more like tasty delicacies.

3. *Bread, Groats, Porridge, Puddings, Potatoes, Green Vegetables*

The energy-givers needed by our body can be as well supplied by protein and fat as by carbohydrates, but as in future we have to reckon with a certain scarcity of protein and fat, we must pay particular attention to the carbohydrates for this purpose. The first foodstuffs to be considered are those which contain starch, *i.e.*, bread and other products from corn, potatoes, and green vegetables.

So far as bread is concerned, the main point is that more rye bread and less wheaten bread should be eaten. We have lost an import of two million tons of foreign wheat and in its place we have more than that amount of rye so long as the export is forbidden even if the prohibition in regard to cattle fodder is only partially successful. Our way of living can be easily adapted to this circumstance because there is no reasonable ground for giving wheaten bread the preference. Rye bread has a greater nutrient value than wheaten bread. At present, of course, wheaten bread is made chiefly into rolls and rye bread into large loaves, but rye flour can also be made into rolls, and this is already done in many forms. At present wheaten bread is generally made from finely-ground grain while rye bread contains a large proportion of the bran, but rye bread can also be made from finely-ground grain. Anything so superficial as the somewhat whiter colour of wheaten bread should be the least reason of all for resisting a more extensive use of rye bread.

Rye bread, according to an order of the Federal Council (p. 170), contains an addition of at least 5 per cent. of potato flour. There is no objection to eating the potato bread made with an addition of 20 per cent., and distinguished by the letter K, provided that the price conforms to the smaller protein content and the price of the potatoes. In potato bread with a still greater addition of potato, of which the percentage is marked on the loaf, the customary protein content of bread is so much diminished (according to the size of the addition) that it can only be eaten with impunity together with foodstuffs which are rich in protein.

Should we eat wholemeal bread or fine bread? Wholemeal bread, which contains nearly the whole of the bran with the flour, is sold in very different forms, coarse bread, Graham bread, Simons bread, Schlüter bread, Steinmetz bread, Rhenish, Hamburg, and Bremen black bread, pumpernickel, etc. On the other hand, very fine bread contains only about 60 per cent. of the grain weight, owing to the very extensive extraction of bran. Its use is now forbidden by the Federal Council because of the great waste in its preparation (p. 169); the flour for rye bread must contain at least 72 per cent. of the grain weight, and that for wheaten bread at least 75 per cent. The kind of bread within these limits which should be preferred depends on the digestion of the individual. Wholemeal bread and similar breads contain indeed more useful protein, but also a large amount of other constituents which cannot be fully utilised and if eaten largely they cause indigestion in many people. A bread which can be universally recommended is one in which the order of the Federal Council is exceeded and from 75 per cent. to 80 per cent. of the grain weight is used as flour. Such bread is to be had everywhere in different forms. These include the ordinary grey bread and many kinds of not too white, but at the same time not too small, rolls.

Should we eat rolls or loaves? At present rolls are as a rule made from wheat flour, but the Berlin caraway rolls, the Munich caraway rolls, the Rhenish rye-rolls, etc., are made from rye flour. Loaves are made mostly of rye or of a mixture of rye and wheat. The preference for the little rolls is due principally to the pleasant taste of the crisp crust. Loaves are preferred more for economical reasons, but owing to their simpler preparation they are cheaper and also keep fresh longer. In the towns, especially in hotels and restaurants, more rolls are eaten and in the open country more loaves. There is no doubt that both forms of bread will be retained in future. People who prefer rolls should ask for rye rolls and then the bakers would prepare them in sufficient numbers.

Corn is used for food in many other forms besides bread and other baker's goods, especially as flour, but also as vermicelli, macaroni, pearl barley, semolina, green corn, groats, ground buckwheat, and millet.

It is very desirable that the use of these foods should be considerably extended. They can be made into numerous and very nourishing dishes which would be very valuable to us owing to our lack of fat. They do not tempt us to use fat to the same degree as bread does, but they offer the opportunity of conveying considerable nutriment to the body at a cheap price and in a pleasant form by the use of skimmed milk and sugar.

A large use of groats, porridge, and puddings, also prepared with sugar and skimmed milk, can help very much in compensating for the lack of meat and fat. Children should be given such dishes frequently; they will greet them with delight and thrive excellently on them. The amount of meat and fat set free in this way will allow the adults not to deviate too far from their customs, but it is also desirable that they should replace meat on some week-days by sweet puddings.

In South German and Austrian cookery puddings and porridge already play a very great part at the midday meal, as well as at breakfast and supper. There are many kinds which are very palatable. They are often prepared without an egg or with very little egg and many kinds of nourishing ingredients are added. At a time when the brotherhood of the German races is so fully brought home to us we have only to introduce into North and Middle Germany the excellent South German dishes, and a great stride is taken towards the adaptation of our diet to the present siuation.

We now eat about 14 million tons of potatoes a year and keep about twice that amount for cattle fodder, distilling, manufacture of starch, and other purposes. Therefore if need be our consumption of potatoes can be considerably increased, especially in South Germany, where they are eaten much less than in North and West Germany.

In using potatoes the great losses caused by improper peeling must be avoided. In the very common method of peeling the potatoes first and then cooking them a large part of the edible portion of the potatoes is thrown away with the inedible skin; how much is thrown away depends on the size of the potatoes and the care with which they are peeled, but in general we may estimate the loss at about 15 per cent., that is, a yearly loss for the whole of Germany of over two million tons of potatoes.

In order to avoid this loss entirely the potatoes must be cooked first and peeled afterwards (potatoes in their skins). The taste arising from the peel can be removed by soaking the peeled potatoes for another three minutes in boiling salt water. In preparing dishes for which the potatoes must be peeled before being cooked, the loss can be reduced by half by peeling them with the "saving knife" (potato peeler). The new potato flakes, obtained by drying potatoes, can also be used for many dishes.

Potatoes should be used with more variety. In one part of Germany they are only used boiled, as broth, as salad, or with fat as fried potatoes or potato pancake, but in many districts they are also prepared in other ways in which fat is saved, and which offer a pleasant change. Thus the potatoes can be cooked together with little bits of meat or fish, with vegetables, *e.g.*, cabbage or beet, or with fruit.

Green vegetables occupy a special place among vegetable foodstuffs. The chief importance of bread, groats, porridge, and puddings, as well as of potatoes, is their starch content. Green vegetables also contain a certain amount of starch and many contain protein also, but their importance as food lies chiefly in other directions. They are valuable for the minerals which they contain in greater abundance than any other foodstuff, especially lime and iron, but their greatest value lies in their appetising and stimulating properties. Thanks to their diverse and pleasant flavours they make a varied and appetising diet possible, and by mixing them with the potatoes the monotony of potato diet is removed.

The value of green vegetables is not at present sufficiently realised everywhere, and this may be because the tasty and digestible preparation of vegetables requires certain little knacks which though easy to learn are but little known. The defective cooking is frequently disguised by a plentiful use of fat; such an addition cannot be entirely dispensed with but it can be considerably reduced.

4. *Fruit, Sugar*

The second kind of carbohydrate which must help us to supply the energy-givers our body needs is to be found in the foodstuffs containing sugar, especially in fruit and in the sugar obtained from sugar beet.

Fruits play a similar part in our diet to that played by green vegetables, because their importance rests only to a very small extent on their nutrient value. This value lies only in the sugar they contain, which amounts in grapes to 15 per cent., but in apples on an average only to 8 per cent., and in cranberries to 2 per cent. Their chief value is their pleasant taste.

The consumption of fresh fruit has its advantages, but all fruit cannot be eaten fresh, and some fruit cannot be transported without great loss, and is very perishable, so that its use is limited to a certain extent to the district where it is grown and still more by the season.

Preserved fruit and jam are therefore very important in our national food supply. The possibility of preserving fruit or making it into jam very considerably increases the amount of available fruit because the inferior kinds, windfalls, pumpkins, and cucumbers, and the many varieties of wild berries, can be used in this way. The actual fruit preserves have the further advantage of keeping well, and being easy to send away. Above all, preserving fruit helps us to take a large amount of sugar in a pleasant form, and this is of the very greatest importance on account of our lack of fat and the wealth of sugar at our disposal.

The consumption of sugar must be much increased. Last year we exported more than one million tons of sugar; now this sugar can serve as a substitute for other foodstuffs. Such an increase in the consumption of sugar is quite possible. In England and America the sugar consumption per head of the population is nearly twice as big as ours. There, to a much greater extent than with us, jam of all kinds is eaten together with or instead of butter, and many sweet dishes of simple composition are used for dessert.

Sugar is also suitable as a food in its ordinary form. For some years it has been tried as an invigorator in fatiguing marches or in sports. Exact inquiries show that by eating about 12 to 15 grams of sugar at intervals of half an hour the feeling of tiredness can be overcome most effectually. We have been rightly urged, therefore, not to forget sugar of various kinds in sending gifts to our troops in the field. The very common assumption that eating dry sugar produces thirst is incorrect, sugar wets the dry mouth by causing an increased formation of saliva. No want of water appears as an after effect of eating sugar; such a result would indeed be inconceivable, because in the oxidation of the sugar in the body nearly two-thirds of its weight is made into water.

The consumption of pure sugar, however, is somewhat limited owing to the dislike which many adults feel to eating it in large quantities; it is therefore urgently recommended that sugar be used in conjunction with other materials. This refers not only to cheap fruit preserves, but also to sweet pastry and sweet dishes. If we made the good resolution to return to the old German morning gruel a large amount of sugar could be disposed of. A good deal of sugar can also be taken in junket, buttermilk, or sour milk, as well as in the soups made from it. The addition of sugar to coffee and tea is no luxury, but makes these beverages nourishing. It should always be remembered that sugar is no delicacy, but a very valuable foodstuff, which gives the body more nutriment than the same weight of the dearer flour.

5. *Housekeeping*

There is much to be altered in our diet. Vegetable food must take a larger place. At dinner meat dishes must be less prominent and various nourishing sweet dishes must take their place. A change has to be made not only in the principal food but also in many other ways. Rolls should be eaten only for breakfast, and at dinner and supper loaves of rye flour or of rye flour and wheat flour should be used. The widely-spread and senseless extravagance of eating bread with some form of fat for the between-meal in the forenoon, must be given up. Bread alone is sufficient, or bread with fruit or jam. Buttered bread is absolutely superfluous with such fat foods as cheese and ham.

The change recommended will not make our diet more monotonous but more varied. At present the food in many places is very wanting in variety, and it is to be hoped that the situation will prove an inducement to introduce new and good dishes which have hitherto not had sufficient regard paid to them. In themselves these dishes are certainly no less enjoyable than the old ones, for in many large districts they are all common and well liked. Of course, they will not meet with universal approbation; sweet dishes are not for everybody. We are not advocating compulsion to which everyone must submit, but only making recommendations which many will gladly adopt, especially when they realise that by so doing they can live more cheaply and promote our economic readiness for war without any kind of personal loss.

The housekeeper must see that the change in diet does not cause displeasure, so the old dishes must not disappear from the table, but new ones must be added to them. The newly-introduced sweet dishes should alternate with the old salt or sour ones, and the new vegetarian foods with the customary meat ones. Too much zeal might do great harm, and might cause a return to the former inappropriate diet after a short and too incisive change.

Perhaps the task would be made easier if a few dishes for the various meals were named. They spring from quite different parts of the country and are not recommended for uniform introduction into the whole of Germany. Each district should draw from the list the suggestions which comply with local taste, and should add other suitable dishes.

Breakfast and the between-meal.—More rye bread. Wheaten bread less white. With it less butter and grease, more jam, less sausage, more cheese. Meat for breakfast is an unnecessary luxury. Coffee, tea, cocoa, with sugar and milk but no cream. In place of bread and these beverages, whose price will soon rise considerably, rye-meal porridge or oatmeal porridge, with salt or sugar according to taste.

Dinner.—Cabbage soup. Potato soup with little bits of meat or sausage. Soups of green corn, pearl barley, peas, beans, or lentils, all with potatoes. Gruel with skimmed milk. Bread soup with apples. Beer soup with bread or flour. Butter milk soup. Cabbage, beet, turnips, beans, with plenty of potatoes but little fat meat. Sour cabbage with pease pudding. Sour lentils. Butter beans and prunes cooked together. Meat dishes as before, but not daily, and principally for the adults. Herrings, haddocks, and other fish. Dumplings. Vermicelli with jam. Puddings made of flour, potatoes, semolina, rice, all with little egg, but with plenty of sugar and skimmed milk. Puddings filled, or eaten with, cooked plums or apples, plum jam, berry syrups, tomatoes. Alternating meat dinners and dinners without meat, in the cold seasons more meat dinners, in the warm seasons more dinners without meat. At dinners without meat pulse or a dish made with skimmed milk. Not too many sweet things on the same day.

Supper.—Rye bread with whey cheese or other cheese, after a dinner without meat with bacon, sausage, or other meat. Hot dishes either saved from dinner or freshly prepared. Potatoes in their skins with bacon or herring. Dumplings, puddings with skimmed milk and sugar. After a meat dinner more sweet dishes, after a dinner without meat more salt dishes. For the children frequent puddings of flour, semolina, rice, millet, buckwheat, made with milk.

Procuring the foodstuffs is an important matter. According to local conditions it will here and there be possible to produce the foodstuffs at home. This also applies to gardening on a small scale. Even a tiny bit of land can contribute a part of the potatoes and green vegetables required. Keeping useful animals is also to be considered. A pig, a goat, rabbits, poultry make it possible to use up all kinds of refuse which we cannot eat, such as potatoes, and faded vegetable leaves. Material which is suitable for human food, such as bread and grain, should not be used as fodder, because the meat or the milk of useful animals are of less nutrient value than the foodstuffs given to them. In many places it will be possible to make use of the old household crafts and produce foodstuffs that will keep. The pickling and smoking of meat and the preserving of vegetables and fruit are especially valuable.

One thing which can be done everywhere to help our food supply is to buy wisely. Where good foodstuffs, *e.g.*, skimmed milk, jam, rye rolls, are not offered in sufficient quantity, the fact should not be accepted, but the tradesmen should be asked for these foods again and again; then they will soon be forthcoming, the demand will create the supply. It is of great importance that in buying the foods here recommended, such as skimmed milk, sugar or fruit, people should not let themselves be overcharged. There is a danger that the recommendation may incite tradesmen to put up the prices.

Should we lay by larger reserve stores? In general this is not to be advised, but where suitable rooms are available stores of pickled and smoked goods should be made. This is an advantage, because the price of meat will probably rise considerably later on, and at the same time it is an action of general utility, because the more stores that are laid by now the less need subsequent dearth and dearness of meat be feared. Stores of preserved vegetables and fruit are also acceptable, and they also serve the general interest, because preserving saves these very perishable foodstuffs, and further the preserving of fruit helps to utilise the sugar which is now so abundant.

The co-operative stores which exist nearly everywhere could materially help in procuring good food, for instance, by getting skimmed milk from a distance. They should also take the smoking and pickling of meat in hand for their members, and see that good use is made of the larger quantities of very perishable foodstuffs, *e.g.*, fish or game, which suddenly appear on the market. Perhaps they could also undertake the delivery of kitchen refuse to breeders of poultry, etc.

One thing more must be guarded against—that is waste. At present all classes of the population deal much too carelessly with food. One source of waste is that in very many circles too much is eaten. Superfluous food is either imperfectly digested or increases the body weight to the injury of health. We should eat less and masticate better.

Much is also wasted in the kitchen as well as at table. The value of the refuse is frequently not realised. How much can be saved by peeling potatoes properly has already been mentioned. All meat and fish refuse should be carefully used. All bones, skins, sinews, and smoked rinds can be boiled down and used for soups and with vegetables, and from the bones, heads, and roes of herrings good sauces can be made, for instance, for potatoes. The waste from vegetables and fruit should also be used. Cabbage stalks and celery leaves when cut into small pieces make a good seasoning for many dishes, fruit peel and seeds make syrup, soup, and jelly.

Table scraps are treated very extravagantly. The valuable scraps of fat and gravy must not be allowed, as they now are, to flow in enormous quantities into the sewers; they must be collected and if necessary freed from their taste by clarifying in boiling water. Bread and potato scraps must not be thrown away. Bits of bread must be kept dry lest they go mouldy and can be used for soups and puddings.

There may be a waste of foodstuffs in the use of spirit, starch, and soap, because spirit and starch are made from grain and potatoes, and soap to a large extent from edible fat.

Lately the spirit producers have made it widely known that where petroleum is scarce spirit is an excellent substitute. This is true, but we should make as little use as possible of this substitute. Spirit is made from potatoes, so that he who burns a spirit lamp is indirectly burning up potatoes. For many industrial purposes the use of spirit cannot be avoided under some circumstances, but for illumination spirit can often be replaced by other fuel which is not produced from foodstuffs. Therefore anyone who is able to do so should use other means of illumination instead of spirit. The State and local authorities should, however, endeavour to limit the use of spirit for illumination to the irreducible minimum by means of cheap prices for gas and electricity and by extending the works for the production of acetylene.

Like spirit, starch is also made from foodstuffs, especially from potatoes. Therefore as far as possible we should cease to use it for starching clothes. The starching of some articles cannot very well be avoided, but with most articles both for men and women it could either cease entirely or be done with very little starch, for instance, the starched petticoats of women are senseless, though fortunately they are less and less common, and the starched shirt front of men is not only uncomfortable, but unhygienic, because it does not let the air through. At a time when we have to economise our foodstuffs it is out of place to use them in the service of a fashion which is open to criticism.

Finally, we must economise soap in washing clothes, because soap is largely produced from edible fats. We lose a great deal of soap quite unnecessarily by using water which has much lime in it (hard water) for washing, and this wastes the soap. Every degree of hardness of the water, that is, 10 milligrams of lime in a litre of water, means a loss in a hectolitre of the water used of 5·5 grams of chemically pure soap, or about 10 grams of the usual soap of commerce. As Berlin water has 8 degrees of hardness, about 80 grams of soap is wasted with every hectolitre of water. In districts where water has a higher degree of hardness, as in the whole range of the Jura, and in districts where the water is very much "hardened" by the overflow from potash industries, the loss amounts to 350 and more grams of soap to the hectolitre. In these districts it is usual to overcome the difficulty by carefully collecting rain water and using it for washing. Where arrangements for this are not available the loss of soap can be checked by adding soda to the water, which eliminates the lime salts. In general, the use of soap can be reduced by employing more freely soda, chlorine compositions, and the so-called perborates sold under different trade names.

A saving of nutriment is in some circumstances possible by preparing food on a large scale, but this should not persuade anyone to renounce cooking at home. The private kitchen managed by the housewife with pleasure and love has not only great value in family life, but it can be conducted with great economy. This is made easier by the use of modern appliances, for instance, the self-cooker (the cooking box), which everyone can procure cheaply. Courses on cookery and housekeeping should now be held everywhere to give the women of the working classes an opportunity of supplementing their training in housekeeping. Here is a great field of work for women who are seeking for an employment which will be generally useful.

Where the wife has to work away from home many people will, of course, be satisfied if at least a People's Kitchen supplies good food (as is the case in all cities). A properly managed People's Kitchen can save a great amount of nutriment, especially by making use of all scraps. It is able to produce food so cheaply that the customer need not have the oppressive feeling of receiving a gift. The same holds good for factory canteens.

CHAPTER XI

CONCLUSIONS

1. *The Efficiency of the Measures Recommended*

MANY things have been recommended in the foregoing pages, legal enactments, administrative measures, and free action by the individual.

In order that our deficit in foodstuffs may not grow greater every export of foodstuff must cease (pp. 95–101). We must do all in our power to avoid a decrease in the yield of our harvests—securing the necessary seed corn, utilising and increasing the available steam and motor ploughs, producing phosphoric acid and nitrogen for manures (pp. 108–128). Foodstuffs which have hitherto been used directly for human food must not be assigned to the animals which were formerly kept on foreign fodder (pp. 133–158).

We have many other means of decreasing our deficit, among them the extended cultivation of pulse (p. 104), moorland cultivation, extension of the irrigation works in the neighbourhood of large towns, and inland colonisation (pp. 129–132). An important means is increasing the available fodder and utilising it better, which involves a considerable reduction in our live stock (pp. 133–153, 157), and a minor means, increasing the breeding of poultry, etc. (pp. 153–157). Other means to be considered are no longer giving corn to animals (p. 160), ceasing to use grain for the manufacture of starch or alcohol (pp. 161–166), separating the bran less completely from the flour in grinding (pp. 168–170), and further, drying potatoes (p. 172), utilising better the green vegetables and fruit we produce (pp. 173–175), decreasing the production of cream and butter (pp. 179–183), and restricting the use of edible fats in soap, candle, and oil-colour factories (pp. 185–186). Alterations in our way of living are also of importance, above all, reducing the consumption of meat, making greater use of cheese and skimmed milk, and avoiding all waste (pp. 187–211).

It is of great importance to realise what these different measures are capable of achieving.

It is constantly observed how little most people are able to judge the consequences of economic facts. During the war attention has been called to the fact that large consignments of cattle have arrived from Denmark, or that four million kilograms of grain were found in Antwerp. The suggestion has been made that a diligent search for fungi or the breeding of rabbits would contribute to our food supply. Here, as in so many other cases, people have been unable to distinguish between extremely insignificant facts and important ones.

There is only one means of making the consequences of economic facts absolutely clear—numerical expression. The criticism may be offered that this expression is often unsafe, that "figures can be made to prove anything." As a matter of fact, in economic matters we have often to be content with mere estimates, but if they are openly acknowledged as such and their basis is faithfully specified, with all their uncertainty they are still of great value. They lead the discussions of common talk into the region of defined, comprehensible, and examinable assertions. They permit at least a preliminary decision with regard to the meaning of a fact, and by inciting verification they contribute at the same time to obtaining a better decision in the future.

For this reason the attempt should be made to show clearly in figures the significance of the measures for meeting our deficit recommended in this work. We have a deficit in two senses. In nutriment values (calories) we have a deficit only as regards our previous consumption; our physiological requirements, including the unavoidable losses in transit, are still covered, and our task is only to bring the amount of the available calories as near as possible to the amount of the calories which we have hitherto used. In protein, which is vitally necessary, we have a deficit both as regards our previous consumption and as regards our requirements, and the more serious task is incumbent on us of raising the available amount of protein at least to the amount of our requirements and the unavoidable losses in transit, but if possible beyond this so as to approach the amount hitherto used.

We now have to find what the recommended measures can contribute towards meeting our deficit. First, it must be made possible to judge what each of them can effect alone, what gain they promise, what sacrifices they require, and, finally, how great is their nett yield of calories and protein. Considered in this way each measure clearly shows its relation to the others, purposeless activity in the wrong place is avoided, and the attention of the authorities and of the population is directed to the great and decisive means of help. At the same time, many measures from which much has been hoped will be proved to be of little account and others which were thought little of will come into the foreground.

Afterwards a decision must be made possible with regard to the total results obtainable from all the measures recommended. The question is, if all that is here proposed is done, will our food supply hold out during a war lasting for years or will it not? The answer is of the greatest significance. Only when the certainty of success stands clearly before all eyes will the authorities and the population take upon themselves with pleasure and love the many exertions, discomforts, and sacrifices which are here demanded. This belief in success is not to be won by protestations as to the value of the proposed measures be they never so well meant, but only by a clear numerical presentation of the effect of such measures.

In a number of cases an exact calculation can be given, for instance, how much nutriment value could be saved by prohibiting the manufacture of alcohol from grain. In other cases, only estimates are possible; for instance, when we are considering what nutriment value can be gained by making a fuller use of our vegetable and fruit production. Where such estimates are given they are always put at the minimum result expected, so that there shall be an under-valuation of a measure rather than a dangerous over-estimate.

The calculation to be made in accordance with these principles must not be misunderstood. It is not intended to show to what extent our deficit *will* be met by the measures recommended, but how far, with due regard to human weakness, it *can* be met. This work is not able to do more than point out the way towards meeting our deficit, to specify suitable measures, and to show the effect which they *would* have if they *were* carried out. It is for the authorities and the population to see that what is recommended is done, and that the meeting of our deficit only contemplated here as a possibility, becomes an actual fact.

2. *The Result in Detail*

In a few cases the results of the measures recommended cannot be expressed numerically, this applies particularly to those intended to prevent a lessening of our harvests, as under normal conditions harvests vary enormously. The effect of greater cultivation of fodder plants, extension of town irrigation works, and increased inland colonisation cannot be exactly estimated, because only somewhat indefinite demands can be made in these cases. Extended cultivation of pulse and increased breeding of poultry, etc., could only be recommended with reservations, paying due regard to the local conditions therefore here also a result could not be calculated. Finally, the nutriment values lost in the production of cream and in the manufacture of soap, candles, and oil colours, are sometimes so small and sometimes so difficult to determine that as regards a future saving of nutriment values it would be better not to take them in account.

A numerical expression of all the other measures should be attempted. One of them, the increased use of sugar as fodder, brings a loss of nutriment with it, but we can include it in the measures proposed in order to avoid too great a reduction in stock keeping. We recommended as the most suitable form the use for fodder of sugar chips (pp. 177–179) in the preparation of which about 20 per cent. of the sugar is left in the beet chips. If we extracted the sugar thus incompletely from all our sugar beets we should use 20 per cent. of our yearly production for fodder, but we can hardly recommend that the incomplete extraction should apply to more than a third of our sugar beets, so that about 7 per cent. of our sugar would be used to feed animals. On the basis of an average sugar production for the years 1912 and 1913 of 1,892,000 tons, this would mean using about 130,000 tons of sugar for fodder.

As human food this sugar, with a content of 3,910 calories to the kilogram, would have supplied 508·3 milliard calories. If it is used for feeding pigs, where its utilisation is most advantageous (pp. 135–136), 44·3 per cent. of these calories would be obtained for human nourishment in the form of fat, that is, 225·2 milliard calories. In using sugar as fodder, therefore, there is a loss of nutriment amounting to 508·3 - 225·2 = 283·1 milliard calories.

All the other suggested measures cause a gain in nutriment values, and, what is of importance in view of our scarcity of protein, also a gain in protein.

What kind of profit can moorland cultivation bring us? Without exaggeration we may assume that of the million hectares of uncultivated lowlands we have in Germany, at least 50,000 hectares could be cultivated during the first year of the war. Putting the amount of work done by a prisoner of war at only a third the normal amount, one man can dig one *are*[1] a day, and reckoning five months to the beginning of May with 20 working days in each, this makes 1 hectare. By employing 50,000 men it is easily possible to cultivate 50,000 hectares.

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[1] 1 *are* = 100 square metres = 119·6 square yards.

We may go further and assume that on these 50,000 hectares of land the particularly profitable potato will be cultivated. One hectare of good improved moorland gives 180 to 220 double zentners of potatoes. Allowing a crop of 180 double zentners and deducting 20 double zentners for planting, there would be a gain from the 50,000 hectares of 50,000 × 160 double zentners = 800,000 tons of potatoes. A kilogram of potatoes contains 740 calories and 1·3 per cent. of protein, so that the 800,000 tons would have a nutriment value of 592 milliard calories and contain 10,400 tons of protein. With every 50,000 hectares of lowland which we take into cultivation during the course of the war we shall obtain the same nett profit.

What gain will there be to our food supply with a change in our stock keeping by which 1 million cows are removed as bad fodder utilisers, 3½ million less pigs are fattened so that the fodder used for them may be given to the cows, and above all a more careful use of fodder takes place?

Without changing our stock keeping the missing import of foreign fodders would mean a loss of dairy produce, containing 6,168 milliard calories and 303,700 tons of protein on an average for the years 1912 and 1913, but with the recommended change in our stock keeping the loss would be only 10 per cent. of our dairy produce, though of course we should have to sacrifice the meat and fat of 3½ million pigs.

On an average for the years 1912 and 1913 our total dairy produce contained 11,633 milliard calories and 478,500 tons of protein. After changing our stock keeping one-tenth will be missing, that is 1,163 milliard calories and 47,900 tons of protein. In comparison with the losses without the change we shall save 6,168 - 1,163 = 5,005 milliard calories and 303,700 - 47,900 = 255,800 tons of protein. This gain of course is reduced by the 3½ million pigs. Each provides 607,750 calories and 11 kg. of protein, altogether 2,127 milliard calories and 38,500 tons of protein. Deducting this loss from the gain in dairy produce we still have 5,005 - 2,127 milliard calories and 255,800 - 38,500 tons of protein. The nett profit from the alteration in our stock keeping amounts to 2,878 milliard calories and 217,300 tons of protein.

What profit will come to our national food supply from prohibiting the use of corn as fodder, provided that every farmer regards it as a matter of honour to observe the prohibition? We may assume that principally rye was used for fodder and that the amount used was 2 million tons.

Rye flour must contain 72 per cent. of the grain, but we may assume that the average rye flour contains at least 78 per cent. because much wholemeal bread and other rye bread containing a large amount of bran is eaten, so that 20 per cent. of the grain becomes bran. According to this proposition the 2 million tons of rye produce 1,560,000 tons of rye flour with 3,220 calories to the kilogram and 6·7 per cent. of protein, altogether 5,023 milliard calories and 104,500 tons of protein.

There is, it is true, a loss to be set against this gain. If the rye were still used as fodder it would be in order that the fattening of pigs might not be so much restricted. We should not use it to keep more cows, because the elimination of the worst fodder utilisers is expedient. Without being too inexact we may proceed in this case as if the rye meal would be used for fodder as well as the bran. In pig-fattening calories are only utilised to 44·3 per cent. and protein to 24·4 per cent., so that instead of the 5,023 milliard calories and 104,500 tons of protein we should still gain for human consumption 2,282 milliard calories and 26,200 tons of protein by using rye in this way.

According to this our nett profit from the prohibition in regard to fodder is 5,023–2,282 milliard calories and 104,500–26,200 tons of protein. It amounts to 2,741 milliard calories and 78,300 tons of protein.

What profit would result from prohibiting the manufacture of starch from wheat? Wheat starch is used for human food, but in its preparation the protein in the flour becomes cattle fodder. By prohibiting the manufacture of wheat starch we should gain the excess of the value of this protein when used directly for human food over its value when consumed in the form of animal products or, as it would probably be most correct to say, in the form of milk. According to statistics for the year 1911, 22,700 tons of wheat meal were made into starch. As the starching of clothes must be restricted the whole consumption of starch will decrease (p. 120), so we need not reckon as if the prohibition to manufacture wheat starch would result in an increased manufacture of potato starch. We can simply ask what nutriment value the prohibition would save.

If the 22,700 tons of wheat flour were directly consumed the 8·8 per cent of protein and 360 calories to the kilogram which they contain would come unchanged to the human food supply, that is, altogether, 8·2 milliard calories and 2,000 tons of protein. On the other hand, if wheat flour is taken in the form of starch, man receives in protein only the 36·3 per cent. which becomes milk, that is, only 3·0 milliard calories and 700 tons of protein. Prohibiting the manufacture of wheat starch would therefore bring in 8·2–3·0 milliard calories and 2,000–700 tons of protein for human nourishment, that is, a gain of 5·2 milliard calories and 1,300 tons of protein.

What can we gain by prohibiting the manufacture of alcohol from grain? This alcohol is drunk, and in its preparation distillers' wash is produced, which we must count as milk fodder. With the prohibition we should have in place of these, flour for direct consumption and also bran, which must also be put down as milk fodder.

In 1912–13, 89,000 tons of rye were used in grain distilleries. In the event of a prohibition this rye, if it were ground to 78 per cent. rye meal and 20 per cent. bran (p. 219), would provide 69,400 tons of rye meal and 17,800 tons of bran. The rye meal (3,220 calories and 6·7 per cent. protein to the kilogram) would furnish for human food 224 milliard calories and 4,700 tons of protein. The bran (2,575 calories and 12·5 per cent. of protein to the kilogram) would contain 45·8 milliard calories and 2,200 tons of protein, and if used in the production of milk (23·6 per cent. of the calories and 36·3 per cent. of the protein) would furnish, in the form of milk, a further 10·8 milliard calories and 800 tons of protein. Altogether this would be a profit of 224 + 10·8 = 234·8 milliard calories and 4,700 + 800 = 5,500 tons of protein.

This gain is reduced by the following loss. One ton of rye produces 3·33 hectolitres of alcohol with 5,250 calories to the litre, and also 0·24 ton of dry distillers' wash with 2,062 calories to the kilogram and 9·7 per cent. of protein. The 89,000 tons of rye, if used for distilling, would produce 297,000 hectolitres of alcohol and 21,400 tons of dry distiller's wash. The alcohol would contain 155·8 milliard calories. The distiller's wash would contain 44·0 milliard calories, and by way of the milch cow (calories utilised to 23·6 per cent. and protein to 36·3 per cent.) would provide for human nourishment 10·4 milliard calories and 800 tons of protein. That would be a total loss of 155·8 + 10·4 = 166·2 milliard calories and 800 tons of protein.

The prohibition to manufacture alcohol from grain would therefore bring in 234·8–166·2 milliard calories and 5,500 - 800 tons of protein, that is a nett profit of 68·6 milliard calories and 4,700 tons of protein.

What can potato drying do for the national food supply? On an average for the years 1912 and 1913 we produced about 50 million tons of potatoes. By making a good use of the existing apparatus we could dry at least 2½ million tons of potatoes annually; this amount absolutely must be increased to 4 million tons by establishing further apparatus, because the number of potatoes which are annually lost by decay, etc., is estimated at this amount. As drying will diminish the number of potatoes stored there will be fewer to decay, and we may assume that 50 per cent. of those dried would otherwise have been lost by decay. Therefore the 4 million tons suggested would mean the saving of 2 million tons of potatoes.

In view of the large amount of potato at present added to bread we can reckon that half the dried potatoes are used directly for human food and half as pig food. Potatoes contain 890 calories to the kilogram and 1·5 per cent. of protein, but, after deducting the loss in peeling, only 740 calories and 1·3 per cent. of protein.

The million tons eaten by man therefore provides 740 milliard calories and 13,000 tons of protein. The million tons used for pig food contain 890 milliard calories and 15,000 tons of protein; as only 44·3 per cent. of the calories and 24·4 per cent. of the protein are regained in the form of meat and fat, they provide 372·3 milliard calories and 3,900 tons of protein. Together this is 740 + 372·3 milliard calories and 15,000 + 3,900 tons of protein, a nett profit of 1,112·3 milliard calories and 18,900 tons of protein.

What profit will the preserving of green vegetables bring us? We may estimate our consumption of green vegetables of our own production at 6 million tons a year. In view of the difficulty of preserving large quantities of vegetables we must not put the profit from preserving too high, but without exaggeration we may certainly assume that with suitable preserving the available home-grown vegetables could be increased by 5 per cent., that is, by 300,000 tons a year.

We have put the calorie contents of green vegetables at 310 per kilogram and the protein contents at 1·2 per cent. (p. 45). The 300,000 tons of green vegetables which we could save by preserving, therefore, mean a nett profit of 93 milliard calories and 3,600 tons of protein.

What will the preserving of fruit bring? Our consumption of fruit grown in the country can be reckoned as 2,542,900 tons (p. 46). In considering the fruit we are not concerned with such large quantities as in dealing with vegetables, and the possibility of utilising our sugar is a great incentive to preserving fruit so that we may assume that by means of preserving we can increase the amount of fruit available for us by 10 per cent., or 254,290 tons a year.

The nutriment value of fruit varies considerably; the

2,542,900 tons of home-grown fruit showed a calorie content of 1,475 milliards with 17,000 tons of protein. Therefore the 254,290 tons of fruit to be saved represent a nett profit of 147·5 milliard calories and 1,700 tons of protein.

How great is the profit which we can obtain by restricting the making of butter in favour of other dairy products? A restriction of butter making cannot of course be demanded to any far reaching extent in view of the lack of other fats. It would probably be best to assume that our consumption of other dairy products must not be diminished in spite of the missing tenth of our milk (p. 145), so the production of butter must be restricted to the full amount of this tenth.

Of the 19,601 million litres of cow's milk which our dairies have hitherto produced for human consumption (average for 1912 and 1913) we have lost 1,960 million litres of which about 52 per cent. or 1,019 million litres were made into butter (pp. 66–67). If we wish to keep our consumption of milk and cheese unchanged we must not reduce the milk for butter-making by 1,019 million litres only, for then 52 per cent. of our milk would still be made into butter, but we must withdraw from butter-making a full 1,960 million litres of milk, that is 941 million litres more, so that a good 48 per cent. of our milk would be used for the production of butter.

In this way we gain the butter milk and skimmed milk which, had 941 million litres of milk been made into butter, would have been used for cattle food, and which we can now enjoy in the form of milk and rich cheese. 941 million litres of milk weigh (specific gravity 1·031) 970,200 tons. When 100 kilograms is made into butter it produces besides 3·8 kilograms of butter, 12·2 kilograms of butter-milk and 82 kilograms of skimmed milk. 970,200 tons of milk would therefore produce 118,500 tons of butter-milk and 795,600 tons of skimmed milk. We may assume that four-fifths of the butter-milk, that is 94,800 tons and three-fifths of the skimmed milk, that is 477,300 tons, would have been used for fodder (p. 67). Butter milk has a calorie content of 390 to the kilogram and a protein content of 3·6 per cent., so that with the 94,800 tons of butter milk 37·0 milliard calories and 3,400 tons of protein would have been given as fodder. Skimmed milk contains 350 calories to the kilogram and 3·4 per cent. of protein so that with the 477,300 tons of skimmed milk 167·1 milliard calories and 16,200 tons of protein would have been used for fodder. If the 941 million litres of milk are not made into butter there would be a gain to human nourishment of 37·0 + 167·1 = 198·1 milliard calories and 3,400 + 16,200 = 19,600 tons of protein.

On the other hand, we lose the nutriment values which would have become meat and fat if the butter milk and skimmed milk had been used for fodder. In pig fattening the calories are utilised to 44·3 per cent., and the protein to 24·4 per cent. Therefore if the 198·1 milliard calories had been used for fodder we should have regained 87·7 milliard calories and of the 19,600 tons of protein we should have regained 4,800 tons. These nutriment values we shall lose.

The restriction of butter-making so as to keep our consumption of milk and cheese undiminished would therefore bring us in 198·1 – 87·7 milliard calories and 19,600 – 4,800 tons of protein. This would be a nett profit of 110·4 milliard calories and 14,800 tons of protein.

The immediate consumption of skimmed milk by man must be at least doubled and his consumption of skimmed milk cheese increased by half. We may estimate that hitherto about one-fifth of our skimmed milk was drunk, one-fifth made into cheese, and three-fifths used for fodder (p. 67). The required increase in the direct consumption by man would therefore mean that four-tenths of the skimmed milk would be drunk by man, three-tenths made into cheese, and only three-tenths used for cattle food. What profit would this bring?

We have estimated the amount of milk hitherto made into butter at 10,193 million litres. If, as is here recommended (p. 224), this amount is reduced by 1,960 million litres on account of the reduction in our milk production, 8,233 million litres of milk would still be made into butter. This milk weighs 8,488,200 tons, and produces 6,960,300 tons of skimmed milk.

If we were to proceed in our usual way, 1,392,100 tons of this skimmed milk would be directly consumed, 1,392,100 tons made into cheese, and 4,176,200 tons used for fodder. The directly consumed skimmed milk contained 487·2 milliard calories and 47,300 tons of protein. The skimmed milk made into cheese yielded seven-eighths of its weight, that is 118,800 tons of whey cheese containing 307·7 milliard calories and 40,200 tons of protein. The skimmed milk, together with the whey used for fodder, contained 1,761·1 milliard calories and 152,700 tons of protein, and produced in the form of pork and fat 780·2 milliard calories and 37,300 tons of protein. The total profit for human nourishment would therefore have amounted to 487·2 + 307·7 + 780·2 = 1,575·1 milliard calories, and 47,300 + 40,200 + 37,300 = 124,800 tons of protein.

As soon as we consume directly 2,784,100 tons of this skimmed milk, make 2,088,100 tons into cheese, and use only 2,088,100 tons for fodder, the result to our food supply will be very different; then we should receive in the directly consumed skimmed milk 974·5 milliard calories and 94,700 tons of protein, in the skimmed milk made into whey cheese 461·5 milliard calories and 60,200 tons of protein, and in the meat and fat produced from the skimmed milk used as fodder 390·1 milliard calories and 18,700 tons of protein. The total profit for human nourishment then amounts to 974·4 + 461·5 + 390·1 = 1,826 milliard calories, and 94,700 + 60,200 + 18,700 = 173,600 tons of protein.

The doubling of our immediate consumption of skimmed milk and the increase of our consumption of skimmed milk cheese by half would bring in for human nourishment 1,826 – 1,575·1 milliard calories and 173,600 – 124,800 tons of protein, or a nett profit of 250·9 milliard calories and 48,800 tons of protein.

It is extremely difficult to estimate what amount of profit would be gained from the people resolving to avoid wasting nutriment; in any case the waste in human feeding cannot be diminished to the same extent as in feeding animals, for man feeds himself and cattle have their food alloted to them. We may, however, assume that nutriment could be saved which would supply 10 per cent. of our calorie requirements and 5 per cent. of our protein requirements.

There are grounds for this assumption. In the Berlin sewers 20 per cent. of table fat daily per head of the population has been found; as 1 gram of fat contains 9·3 calories, 186 calories for each person reach the sewers of Berlin daily. In the present way of peeling potatoes at least 15 per cent. is lost; as we consume 14 million tons of potatoes yearly, this means 2·1 million tons in a year, and 1,554 milliard calories, as a kilogram of potatoes contains 740 calories. Assuming that half these potato peelings were used for pig food, and thus utilised to 44·3 per cent., 344 milliard of the 777 milliard calories would be regained; but there still remains a loss of 777 + 433 = 1,210 milliard calories yearly for Germany, or a daily loss of 48 calories for each person. Therefore the losses in fat and potatoes alone amount to 186 + 48 = 234 calories per head of the population daily. To these mainly unnecessary losses, however, many others have to be added; enormous quantities of bread, vegetable, fruit, and other scraps are wasted. It is, of course, impossible to avoid every decay of foodstuffs, but when we reflect that on an average a man only requires 2,260 calories daily, and that in fat and potatoes alone 234 calories are lost, we must acknowledge that a saving of calories amounting to 10 per cent. of our requirements is absolutely possible.

The waste of protein is not so great as in the total calories. The higher price of foodstuffs which are rich in protein causes them to be more carefully used. A good deal of protein is, of course, lost with the bits of potato and bread as well as with scraps of meat, it would be more prudent to expect a saving of protein amounting to 5 per cent. of our requirement.

We have calculated the nutriment requirement of the German nation to be 56·75 billion calories and 1,605,000 tons of protein, and of this one-tenth of 56·75 billion calories and one-twentieth of 1,605,000 tons of protein could be saved. The resolution of the population to avoid every waste could bring us a gain of 5,675 milliard calories and 80,000 tons of protein.

3. *The Effect in General*

It is now possible to review the recommended measures as a whole and to realise what they can do together to meet our deficit. At the same time it will clearly be seen what degree of importance each of them has in relation to the others.

Quite a number of measures could be expressed numerically: the use of sugar for fodder (pp. 216–217), moorland cultivation (pp. 217–218), the change in our stock-keeping (p. 218), the prohibition to use bread corn as fodder (pp. 219–220), the prohibition to manufacture wheat starch (pp. 220–221), the prohibition to manufacture grain alcohol (pp. 221–222), potato drying (pp. 222–223), the preserving of vegetables (p. 223), the preserving of fruit (p. 223), the reduction of butter making (pp. 224–226), the increased consumption of skimmed milk and skimmed milk cheese (pp. 226–227), the avoidance of the waste of nutriment (pp. 227–228).

For other measures we were obliged to forgo numerical expression (p. 216). It is much to be regretted that for this reason the arithmetical summary of the results of this work is not quite complete, but the picture would not be much altered by the addition of those measures, because most of them are somewhat insignificant. The important ones, however, particularly the provision of seed corn, steam and motor ploughs, and manures, do not aim at meeting the existing deficit, but at preventing it from becoming greater.

The numerically expressed measures are here summarised so as to show to what extent they are able to increase the nutriment values now at our disposal. They are arranged according to the protein which they produce, because the meeting of our protein requirements must cause us more anxiety than the provision of the required calories (p. 80).

THE MEETING OF THE DEFICIT.

Nutriment Values.	Protein in 1,000 tons.	Calorie Milliards.
Requirement	1,605·0	56,750·0
Actual consumption before the war ...	2,307·0	90,420·0
Available with unchanged economic customs	1,543·0	67,860·0
Add: Change of stock-keeping	217·3	2,878·0
Avoidance of waste	80·0	5,675·0
Prohibition to use bread corn for fodder	78·3	2,741·0
Increased consumption of skimmed milk and skimmed milk cheese...	48·8	250·9
Potato-drying	18·9	1,112·3
Reduction of butter-making ...	14·8	110·4
Moorland cultivation	10·4	592·0
Prohibiting the manufacture of grain alcohol	4·7	68·6
Preserving vegetables	3·6	93·0
Preserving fruit	1·7	147·5
Prohibiting the manufacture of wheat starch	1·3	5·2
Deduct: Use of sugar for fodder	—	— 283·1
Available if the recommended measures are carried out	2,022·8	81,250·8

We can see that the efficacy of the recommended measures is great. The available amount of nutriment values rises very considerably, the calories by 20 per cent. and the protein by 30 per cent. Our protein requirement is also met and indeed so fully that allowance is made for the unavoidable losses in transit; the available calories exceed our requirement by 44 per cent. and the available protein exceeds it by 26 per cent. It is, of course, not conceivable that without imports there would be the same amount of nutriment available as before the war, but the available amount is, however, very close to that amount; in calories we have lost only 11 per cent. instead of 25 per cent., and in protein only 13 per cent. instead of 33 per cent. of what was formerly available.

This favourable result holds good, not only for the present moment, but for the war, even if it lasts for years. With conscious intention we have left out of account everything which might indeed contribute to meeting our requirements at the moment, but which is not lastingly assured to us, our stores as well as imports from neutral countries (pp. 18, 13–15). We have even taken full account of the possibility that during the war our production of nutriment values may be reduced by bad harvests or other occurrences.

The favourable result is not assumed with thoughtless expectation, but ascertained with earnestness and caution. In considering our requirements and our sources of help we have reckoned rather too low than too high. The food requirement of the individual is given as if the whole population were in good health, although we have numerous invalids who need less food. The food requirement of the whole nation is based on a population of 68 millions, although the greater part of our army is on enemy land. Many of the means of gaining nutriment, for instance, inland colonisation, increased planting of pulse, extension of poultry breeding, are not expressed numerically at all, and as regards the other means, we have always taken the lowest result expected in making our calculations.

The whole favourable result is, of course, subject to the supposition that what is here demanded will actually be carried out: that the Imperial Government permit no export of foodstuffs; that the authorities strictly uphold the prohibition to use bread grain or fodder and that the farmers observe it; that our stock of pigs be reduced by 9 millions and our stock of milch cows by 1 million; that the waste of fodder as well as the waste of foodstuffs in housekeeping cease; that a sufficient number of prisoners of war be employed in moorland cultivation; and so on. But this supposition will be fulfilled.

We shall hold out. That we can do so is thanks to our agriculture. In the last ten years, under the powerful protection of Governments whose clear foresight recognised the danger of Germany developing into a one-sided industrial country, and through the vigorous actions of distinguished men, agriculture has made a tremendous advance both to its own profit and with the gratifying result that we are able in case of need to feed 68 million people on a territory of a little more than half a million square kilometres without contributions from abroad. We are also indebted to the healthy adaptability of our economic life. A man fits himself the more easily to an outward change of circumstances the better his nervous system reacts, and in the same way a political economy shows a greater adaptability the more nervous energy there is working in it, in the form of strong, intelligent, and thoroughly healthy personalities. Germany's wealth in such personalities has shown itself since the outbreak of war in a surprising way. But above all we must be grateful to two peculiarities of our national character, which we have perhaps not always sufficiently valued: perspicuity and perseverance. On these the authors of this work rely when they cherish the hope that the English starvation scheme, in spite of closed frontiers and raids on shipping, will be shattered by the willing co-operation of millions.

PRINTED IN GREAT BRITAIN BY R. CLAY AND SONS, LTD.,
BRUNSWICK STREET, STAMFORD STREET, S.E., AND BUNGAY, SUFFOLK.